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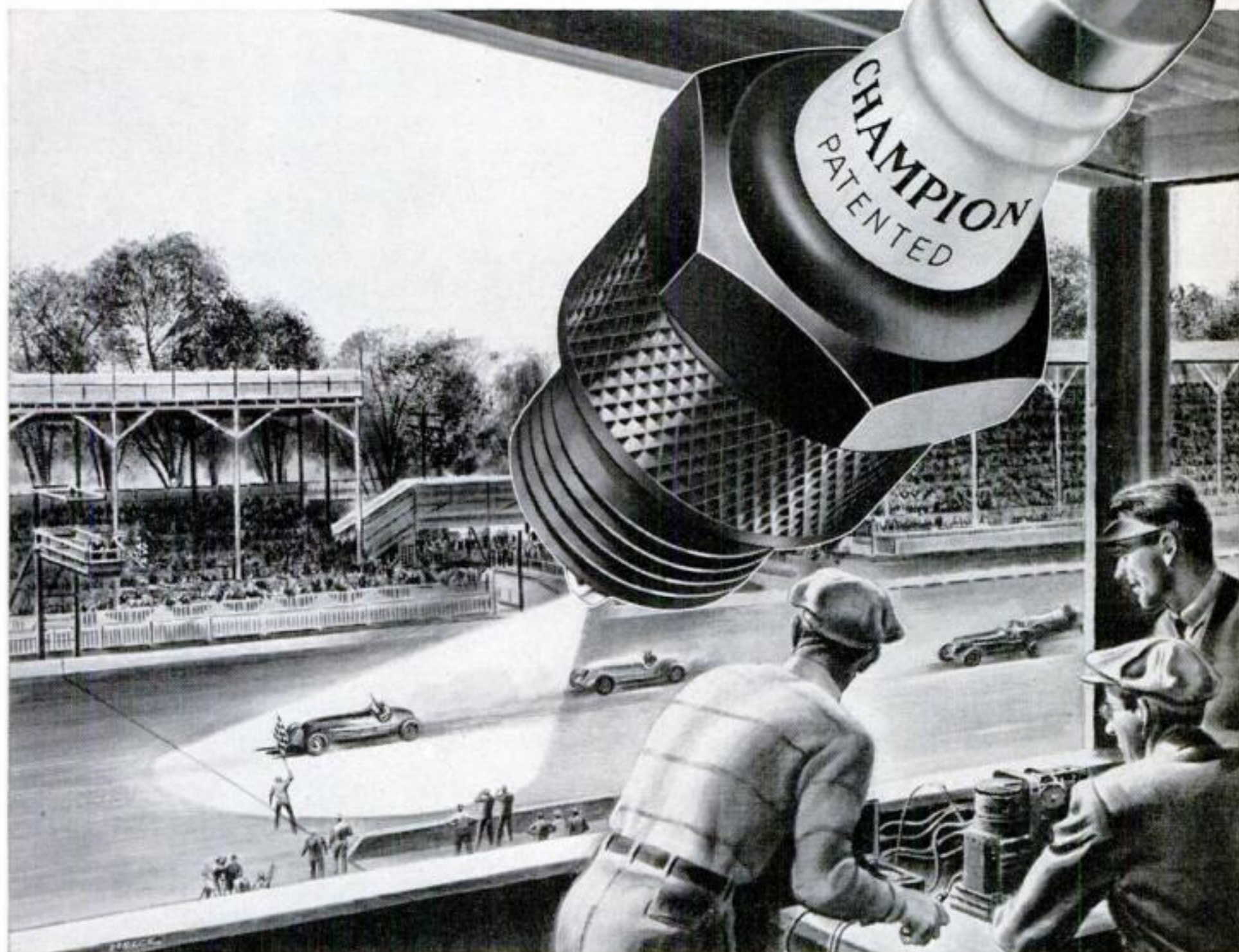
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TEST YOUR

B.K.*



IN THIS BATTERY QUIZ

*BATTERY KNOWLEDGE

QUESTION: What are the three major functions of a storage battery in a car?

ANSWER: (1) To provide a source of current for starting and ignition; (2) to control the voltage of the electrical system; (3) to furnish current when the electrical demands exceed the output of the generator.

QUESTION: Does a battery store up electricity?

ANSWER: No, a battery can store only chemical energy which is produced from the electrical energy of the generator and is caused by the reaction between the sulphuric acid in the electrolyte and the active materials in the plates.

QUESTION: How does the battery produce electrical energy?

ANSWER: The stored-up chemical energy of the plates produces electrical energy when the battery is discharged. This reaction produces lead sulphate and water, which reduces the concentration of acid in the electrolyte.

QUESTION: What is meant by "self-discharge"?

ANSWER: When a battery stands idle, it loses chemical energy. This is "self-discharge," and it is very dependent on temperature. It amounts to one point loss of capacity per day at 70° F., and to nearly three points per day at 100° F. The loss is negligible at 0° F. Therefore, batteries should be stored in a cool place.

QUESTION: In what ways is summer harder on a battery than winter is?

ANSWER: In hot weather evaporation is very high, and unless water is added regularly the electrolyte level will get so low that it does not cover the top of the plates. Another danger is excessive output of the generator. This is more serious in summer because a battery stores up chemical energy faster in hot weather than in cold, with the result that it is more likely to gas and overheat.

QUESTION: What are the dangers of an over-charged battery?

ANSWER: If the generator charging rate is not properly controlled, the generator output may become excessively high, resulting in unnecessary wearing out of the plates. It is, of course, obvious that too low a charging rate will result eventually in a discharged battery.

QUESTION: What make of battery is original equipment in 40 per cent of American cars?

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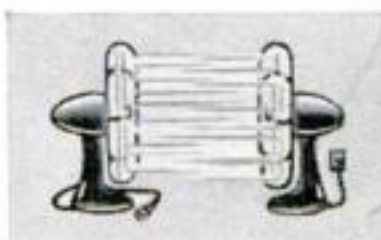
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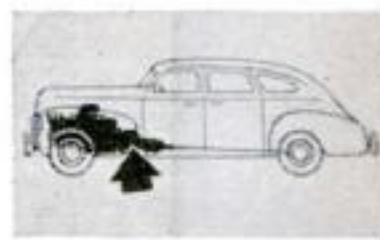
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Our Readers Say

After All, the Human Eye Was the First Camera

PHOTOGRAPHY is a wonderful hobby, no doubt, but I don't think it mixes with travel. Last winter I made a trip through the West Indies with a friend who is a rabid camera fan. Whenever we came to some beautiful scene or historic landmark, he would spend all his time fussing with his films and filters, while I was soaking up the scenery with my eyes. When we got home, he had nothing to show for his trip except a batch of photographs, which he could duplicate in any travel book. The other day we were looking over the pictures he took, and came to a view of the famous old fort at Brimstone Hill, on the island of St. Kitt's. My friend didn't recognize the picture, and asked me what it was. When I told him, he said: "Gosh, did we go there? Why, I wanted to see that place!" (You can take this with a grain of salt. I like to josh the lens hounds because they all take their hobby so seriously. There must be something in a hobby that "gets" fellows that way. In fact, I think I'll take it up myself.)
—L. T., Philadelphia, Pa.

He'd Send the Puzzlers to a Column of Their Own

THIS is the first time I've had a word to say about your magazine. I think it's swell, and so forth, but could you tell me how to make a phonograph pick-up to use on my own radio and constructed from an old earphone? I tried to make one and failed. And, I say, don't make it too technical or too expensive. I always read "Our Readers Say" before even looking up the explanation of the cover picture. I think you print some letters that are a lot of hot air and more letters that really have something to say. Those puzzle fans that talk back and forth in your columns may have a lot of fun, but what about us guys that don't do puzzles? When we read through a letter in there that is a real brain twister, we come out for the next round too groggy to understand a sensible letter. If you must cater to the puzzlers, why not give them a column of their own? Auto hints and short cuts to construction troubles are more universally interesting—especially the former, that's my hobby. Well, enough for that "first time."—F. L. J., Waterville, Me.

SICK THE FIFTH COLUMN ONTO THEM!



Or Have a Wake at Both Ends and Fool the Bombers

IF IT weren't for the white wake and the V-shaped ripples, the aircraft carrier shown in the photograph on page 48 of your last issue would be almost invisible against the water. As a camouflage against bombing planes wouldn't it be a smart idea to provide all battleships with some sort of stern deflector that would break up the wake and prevent the telltale ripples? The wake of a ship not only shows its course but can serve as a means for calculating its speed—two things the crew of a bomber must know if they expect to hit their mark.—J. C. P., Minneapolis, Minn.

WHY NOT PUT WINGS ON 'EM AND LET 'EM FLY, HUH?



Seems Like a Lot of Grass for One Goat To Eat

WHA'D YOU MAKE ME EAT ALL THAT GRASS FOR? BA-A-URP!



B. H. SEEMS to have a nice bag of problems, and his goat problem is very good. I tied my goat to the silo as indicated in the problem in the June issue and found that if the goat could eat 252.3175 square feet of grass in a day, he would clear the field. It might be hard on the goat.—H. J. H., Piedmont, Calif.

At Least, His Explanation Is Not To Be Sneezed At

THERE'S no way of telling just what did happen to the glass pepper shaker A. D. N., of Vancouver, writes about, but I'll offer this explanation. He says that the top broke off with a loud pop just after his mother had filled it with pepper and put it on the table. Now, it is well known that the neck or top section of a glass bottle can be cleanly broken off by tying a string soaked in alcohol or

(Continued on page 14)



IF you're that man, here's something that will interest you.

Not a magic formula—not a get-rich-quick scheme—but something more substantial, more practical.

Of course, you need something more than just the desire to be an accountant. You've got to pay the price—be willing to study earnestly, thoroughly.

Still, wouldn't it be worth your while to sacrifice some of your leisure in favor of interesting home study—over a comparatively brief period in your life? Always provided that the rewards were good—a salary of \$2,000 to \$10,000?

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Our Readers Say (CONTINUED)

gasoline around it, lighting the string, then submerging the bottle in cold water. Some such thing probably happened to the shaker. Perhaps it had just been washed in hot water when cold pepper was added, causing the shaker to crack. Possibly, too, the cap was screwed on too tight, adding to the strain on the glass when it was subjected to extremes of temperature. Or maybe the pet cat flicked it over on the hard table top with its tail. Finally, as your heading suggested, the pepper itself might have been "hot stuff;" so hot, in fact, that the shaker just up and sneezed its head off.—P. W., Toledo, Ohio.

If the Earth Were Flattened No Land Would Remain

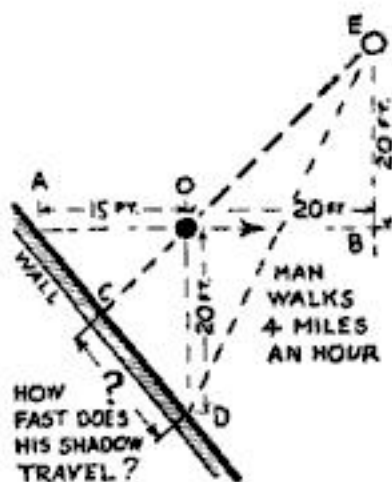
IT WOULD be difficult to praise P.S.M. too highly. It is undoubtedly the best magazine of its type on the market. Although W. D.'s idea of a horn code might work with men, I have never seen a woman driver who looked or listened! Incidentally, I recently heard some one remark that eventually we'll learn to flatten out the earth so there will be no sea. Now there are a few drawbacks. First, all the land would then be one and a half miles below sea level. Second, where would rain come from if there were no ocean for evaporation?—B. T., Dallas, Tex.

IF THAT 1 1/2 MILES OF
WATER DROWNED EVERY-
THING THE WORLD WOULD
BE
PERFECT!



Assume that the Man Is Sober, and the Street Light Lit Up

IN THE accompanying diagram, a man is walking along AB. E is a source of light, such as a street light, and when the man is at the point O, the light throws a shadow at C on the wall AD. Considering only the shadow of the man's head, and assuming that the man's head and the lamp are at the same height from the level ground, at what speed will the shadow of the man's head move along the wall at the instant when the man is at O, if he is moving toward B at 4 miles an hour?



Further facts are: AO equals 15 feet; OB equals 20 feet; BE equals 20 feet; and OD equals 20 feet.—G. G. D., Montreal, Canada.

(Continued on page 16)

He Wrote with a Typewriter —Not a Goose Quill

BY THE time I get through an issue of your magazine, I am always thoroughly mad. There is such a fiendish fascination in the clever gadgets and machines you describe, that I just can't stop reading about them. However, I believe that all our so-called labor-saving devices have done more to destroy true leisure than to save labor. After all, you don't need a push button to help you lie in the shade and rest. Savages don't have labor-saving inventions—and they don't have nervous breakdowns, either.—R. A. B., New Orleans, La.

HAW, BUT YOU USE A LOT
OF ENERGY YELLING FOR
SERVICE - THAT'S BAD!



How To Please Visitors and Win New Readers

THE other day I was visiting a friend, and in the course of my stay I picked up your magazine. Among other things in it there was a most interesting article and photographs by Frank Caporael. It fascinated me. Then and there I decided to buy this magazine every month. Incidentally, a few weeks ago I wrote to a New York newspaper asking about making a fireplace. They recommended that I get in touch with you, and I am indeed grateful for your prompt reply. Yours for continued success. You can count me a new reader.—Mrs. H. F. A., New York City.

GEE, I'M GLAD I HAD TO
COME TO THE DENTIST!



He'd Make the Planes out of Rubber in the First Place

WILL one of your readers please put me straight? On page 71 of your May issue is an article on a novel parachute. At first I thought a conventional parachute was attached to the dumb-bell-shaped arrangement of rubber spheres. But your article states "minus trailing ropes and rip cords," and that seems to contradict this theory. Then again, according to your picture of a model of the device, the spheres in an actual parachute would have to be very large. I can just

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Our Readers Say (CONTINUED)

imagine stuffing forty of them into the hold of a Clipper! What do you do? Drop 5,000 feet and bounce back up 2,000? I'd rather stay in the plane. Why not make a plane of rubber so that it can't crash—it bounces? Maybe I'm crazy but it certainly seems crazy to me!—D. H. D., Brooklyn, N. Y.

Does a Sinking Ship Sink All at Once?

POSSIBLE, IF SOME OF THE BULKHEADS HELD AND WERE WATERTIGHT—LIKE THE BALLAST TANKS IN A SUBMARINE



CAN some reader answer this one for me? After a sinking ship slips beneath the waves, does it go straight down to the bottom? Does it sink quickly or slowly? Would it be possible for a ship to sink half-way down and float there? I think that might happen.—A. G., New York, N. Y.

Remember This the Next Time the Cat Falls in the Well

HERE'S one of those useful ideas that you can store away in your cranium and hope you'll never have to drag out, but which will be valuable indeed if it ever is needed. I'll tell it as it happened. Our small boy was playing by an old drilled well that had gone dry. He had with him a small kitten, hardly half grown. He threw it in the well. My wife heard the kitten meowing in the well. She got some old insulated wire, tied a piece of fresh meat to one end, and lowered it in the well. Kitty grabbed the meat and was quickly pulled out. Some fishing, I think! —C. W. S., Tioga, Colo.

DING, DONG, BELL.
PUSSY WAS IN THE WELL!



Men Must Make the Machines that Make the Machines, etc.

PERMIT me to disagree with L. A., of Augusta, Me., in his theory that machines in time will replace men at work. To a certain extent, it may be true. However, I would like to point out that although machines may replace men in manufacturing, men have to make the machines. If everything is made by machines, where do the machines come from? Men must make patterns and plans, cut dies, experiment, and do a lot of other things before they can produce a new ma-

chine—in quantity or otherwise. I'll go one step further: If machines, instead of men, make machines for manufacturing, men still have to make the machines that make the machines. That's that!—C. A. H., Jr., Wellesley Hills, Mass.

Some States Won't O.K. Sealed-Beam Conversions

YOUR recent article on "Sealed-Beam Lights for Your Old Car" was fine. I tried it and the job was perfect, but when I presented the car for the periodic state inspection they wouldn't pass the lights. It seems that New Jersey has outlawed sealed-beam conversions and will O.K. sealed-beam headlights only when they are part of the car's original equipment. I thought I'd pass along the word, so other readers will check up on their state regulations before going ahead with the job.—A. H. W., Jersey City, N. J.

It's a Swell Break for the Extra Man

REGARDING the article "New Patents Forecast Your 1942 Car," in the June issue, I believe the engineers have committed a gross error of judgment in the design which places the driver's seat up forward—all by itself. Suppose, on a moonlit summer night, a young man arrived at his girl friend's home in one of these new-fangled affairs. Then imagine him hemmed in by shelves while his lady fair remained in the rear seat presumably entertained by the passing scenery. Imagine it, if you can! I therefore conclude that, unless the seating arrangement is changed, this car will never be a success!—C. A. I., Portland, Ore.

YEAH? THE NECKERS WOULD USE THE SHELVES



AS ONE who has made a study of highway safety and its relation to automobile design, I read with keen interest the article in your June issue entitled "Forecasting Your 1942 Car." It seems to me that you are definitely on the right track when you call attention to the car in which the driver sits in the very front of the vehicle. Do not be disturbed if some critics say that the driver will escape injury if he has the engine in front of him. Any thoughtful person will realize that the driver will operate more carefully and sanely if he is in the front of the car where he has a full view of the road and its dangers.—A. W. S., Boston, Mass.

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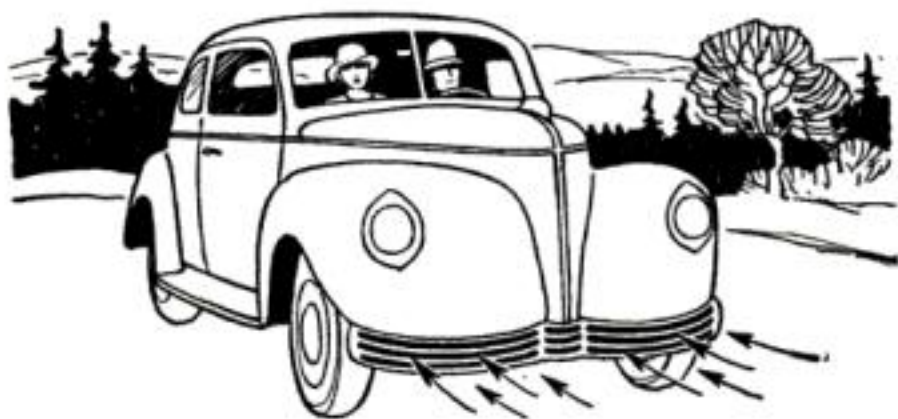
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With the Inventors

IN LINE with the progress of streamlining in automobile design, Vittorio Valletta, an Italian inventor, has developed a car that has a front bumper made with horizontal openings to admit air to ducts leading to



the car's radiator. By using the bumper as an air intake, grilles or other openings in the front of the car are not required. This fact, the inventor believes, permits a more efficient streamline design, and allows a strengthening of the front of the car body by means of a better method of assembly of the fenders and sides . . . **ANY PERSON** who has served for three years in the examining corps of the U. S. Patent Office is not required to take an examination before being registered and allowed to practice as a patent agent or attorney . . . **MOUNTED OVER THE BRIDGE** of a pair of goggles or eyeglasses, a light bulb set in a reflector auto-



matically lights up when the wearer bends his head downward toward the work he is doing. Powered by a pocket dry battery, the light is controlled by a mercury-type switch. It is designed for use by machinists, shop workers, students, and home-workshop fans. The inventor is William O. Anderson, of Chesley, Ontario, Canada . . . **PATENTS ARE NOT GRANTED** for inventions plainly de-

signed for fraudulent purposes, but the fact that an invention made for a legitimate purpose could also be employed for an im-

(Continued on page 20)

proper use, does not bar the inventor from getting a patent on it . . . **A FOLDER OF PAPER MATCHES** that can be made into a toy airplane after most of the matches have been used is a novelty developed by an Oxon Hill, Md., inventor, Orville R. Eaton. The match book is made with perforations so that a child may easily tear the cardboard along certain lines, and bend sections back to form a toy plane, several of the matches being used to simulate a propeller. As a safety precaution, the heads of the matches used as a propeller, the inventor suggests, should be removed before the match book is given to a child . . . **IN THE**



LAST FIFTY YEARS, more than 2,500 patents have been granted for railroad-tie materials other than wood. However, railroads still stick to wooden ties, buying about 50,000,000 a year . . . **WHEN YOU FAIL** to hit the target, you have no kick coming from a novel amusement device developed by Laurence H. Bibus, of Philadelphia, Pa., for use at carnivals, fairs, and amusement parks. As pictured, a contestant throws a ball at a target mounted at the tail of a mechanical donkey, whose hind legs are flexed in kicking position. If the target is hit squarely, the donkey kicks its legs back, releasing the latch on a small springboard that flips a prize into the arms of the contestant. In operation, the device creates the illusion of



the donkey actually kicking the prize toward the ball thrower . . . **IF A NEW MACHINE** is devised to manufacture a novel article, pat-

INVENTORS

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"Why I thought of that years ago!" How many persons have said that, when they found later that somebody else had thought of the same thing, had it patented, sold it, and were profiting from it? Too many, sad to say. These unfortunates did not know what to do about their inventions, in order to protect and profit from them. Some thought elaborate working models were necessary to secure a patent—others felt their idea wasn't "worth much." They failed to realize that a good practical invention, plus prompt action in securing a Patent, and locating a buyer or a good market, have proved the secrets of success for thousands of inventors.

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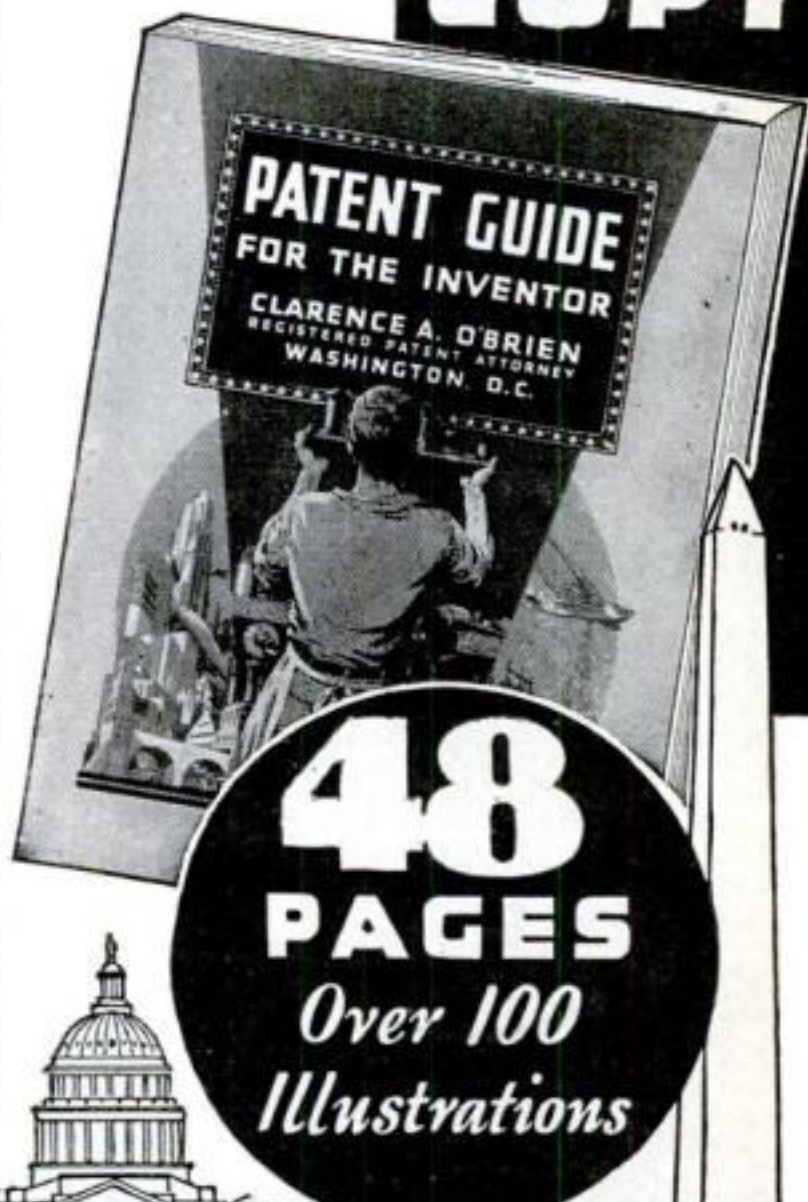
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With the Inventors

(Continued from page 18)

ents may be taken out on both the article of manufacture and the machine . . . **SCORE CARD AND PENCIL**, ash trays, and beverage glasses can't get in the way of card players who use a novel card-table attachment credited to Adolph E. Drexel, of Daytona Beach, Fla. Resting on the four corners of the table, a wire framework holds a con-



venient tray above the center of the table and provides four wire supports to hold drinking glasses. The attachment is designed to fold into a compact space when not in use . . . **AFTER AUGUST 5, 1940**, inventors must apply for a patent within one year of the first public use, sale, or publication of the invention. Otherwise the invention may become public property . . .

AN ICE-CREAM BASEBALL is the novel frozen confection developed by Elmer Texter and Carl Shocknesse, of Detroit, Mich. The ice cream is molded into the form of a baseball and supported on a wooden stick made to resemble a miniature baseball bat. A saucer-shape drip catcher is attached to the stick below the ice-cream ball . . . **PATENT 2,197,536**, on a transmission mechanism, granted to Everett R. Burnett, of Los Angeles, Calif., has forty-eight separate claims, the first one of which consists of a single sentence containing almost 500 words . . .



CURBING accidental firing of rifles and shotguns is the purpose of an ingenious safety mechanism that prevents the firing of a gun unless it is held against a hunter's shoulder

(Continued on page 22)

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With the Inventors

(Continued from page 20)

in normal firing position. A lever-and-pendulum mechanism built into the gun-stock controls a latch locking the gun's trigger. Pressure on the butt of the gun will release the trigger lock, but only when the pendulum is moved by raising the gun to firing position. Herman J. Kneubuehl, of Shanesville, Ohio, is the inventor . . . TO LOCATE CITIES and towns on large wall maps, Rufus J. Kittredge, of Evanston, Ill., has worked out a novel scheme. Using a system similar to that employed in atlases, the map has scales at the top and bottom marked off in numbered divisions,



while scales at either side are marked in lettered divisions. In addition, a vertical bar, also marked off by letters, is suspended from the top and slides back and forth across the map. If by reference to the map's index, for example, the key to the location of a town is found to be "14 N," the vertical

bar is moved to the scale point 14. At or near the letter N on the bar will be found the town sought. A supplementary scale, marked off into miles, may be used to gauge the distance between points on the map. . . . TAKE A DEEP BREATH and stretch your vocal chords on the first claim of a recent chemical patent: "As a new chemical compound the tri-di-

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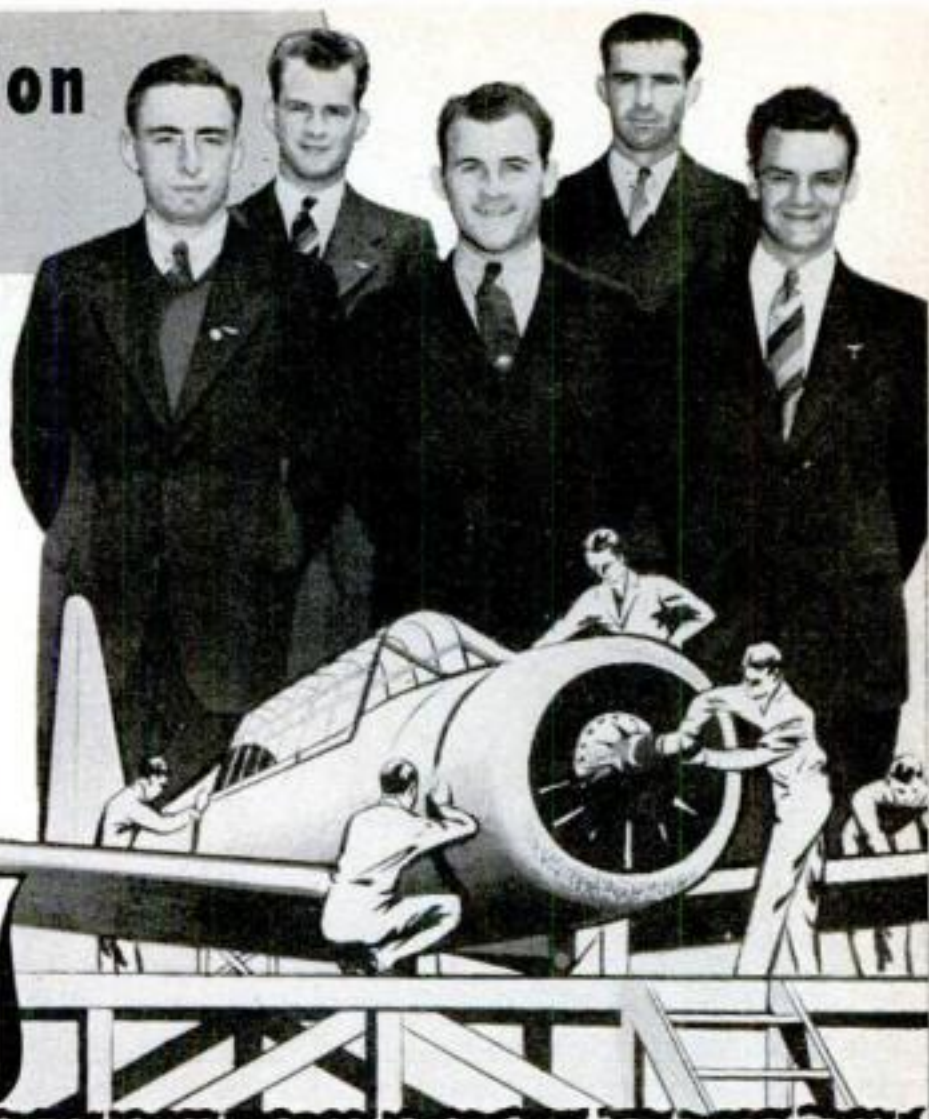
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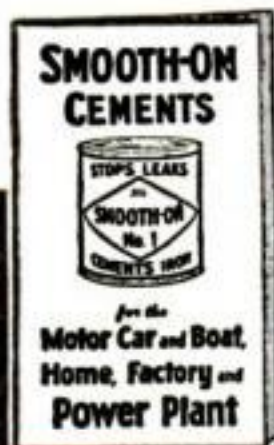
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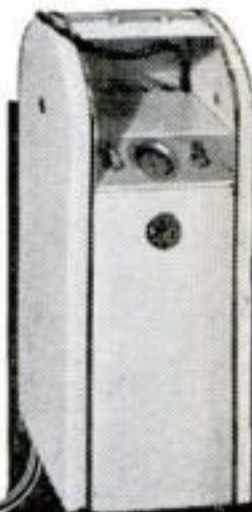
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SENSATIONAL quick - cash opportunity. My route building plan gives you chance for good steady income. Real future. Handle regular route local stores. Collect, deliver orders for famous 5c-10c counter display goods. Nationally advertised in 120 magazines and radio. Show merchants proven plan for beating competition and increasing sales, profits. Experience unnecessary. Use home as headquarters. Chance to operate Silver Fleet Service Truck. Facts free. World's Products Co., Dept. 83-B, Spencer, Ind.

MAKE extra money easily. Sell 50 assorted Personal Christmas cards for only \$1. 14 Box assortments 30c up. Odd cards 2½c each. Send for Free samples exclusive \$1 line Personal cards and imprinted stationery. Request \$1 assortment on approval. New England Art Publishers, North Abington, 351, Mass.

WRITE for Free samples amazing stain-proof tablecloths. Clean with damp cloth. Require no ironing. Beautiful patterns. Look like linen—cost much less. Commissions big. Also complete line of dresses. Melville Company, Dept. 1631, Cincinnati, Ohio.

LOCAL agents wanted to wear and demonstrate suits to friends. No canvassers. Partial payment plan. Up to \$12 in a day. Experience unnecessary. Valuable demonstrating equipment, actual samples Free. Stone-Field Corp., 1300 Harrison, Dept. H-821, Chicago.

CALL on service stations, factories, restaurants, businesses, professions; with lettered advertising uniforms, shirts, work suits, etc. 100 styles. Exclusive features. Also soft-ball uniforms. Big advance commissions. Free outfit. Topps, Dept. L-14, Rochester, Ind.

CHRISTMAS Card Salespeople—Best sellers. You make 50c on new 21-folder \$1 assortment. Christmas Cards with name, 50 for \$1. Other big-profit assortments. Experience unnecessary. 50c sample on approval. Schwer, Dept. T-5, Westfield, Mass.

CHRISTMAS Card Leader brings you quick cash profits. Sensational "Beauty Queen" 21-card assortment sells \$1.00. You make 100%. Ten other fast-selling assortments. Personal Christmas Cards, 50 for \$1, up. Samples on approval. Chilton Greetings, 147 Essex, Dept. T-41, Boston, Mass.

READ CAREFULLY

These Classified Advertisements, under more than 110 classifications, contain a gold-mine of interesting, useful information. Among them you'll find many money-saving and money-making opportunities; new products and services. Make it a habit to read this section every month. It pays.

EXTRA Money Quick! Sell super-value Personal Christmas Cards. 50 — with name—\$1. Finest 21-card assortment, \$1. You make 50c. Complete line. Samples on approval. Waltham Art Publishers, 160 N. Washington, Dept. 310, Boston, Mass.

MAKE extra money easy. Show smart Personal Christmas Cards with name, 50 for \$1, up. Outstanding values. Also 21-card assortment, \$1; others. Big profits. Samples Free. Wetmore & Sugden, 749 Monroe, Dept. 114, Rochester, New York.

SELL 50 Personal Christmas Cards—\$1.00. Amazing bargain! 50 folders with customer's name imprinted. Sells fast. Pays big profits. Free samples. Also unequaled \$1 Christmas Card Assortments. General Card, 400 S. Peoria St., Dept. P-73, Chicago.

EXTRA money—Sell 21 "Personal Initial" Christmas Cards for \$1. Unique metallic gold, silver initials furnished. 100% profit. Name imprinted Christmas Cards 50 for \$1. Other money-makers. Samples on approval. Artistic, 413 Way, Elmira, New York.

YOUR ad in this Classification will reach productive sales-getters for your products or services. Rates on request. Popular Science Classified, 353 Fourth Ave., New York, N. Y.

SELL Personal Christmas Cards with name, 100 exclusive designs, low as 50 for \$1. Complete line fast-selling \$1.00 Box assortments. Up to 100% profit. Samples on approval. Janes Art Studios, 366 Anson Place, Rochester, New York.

PROFITABLE, dignified business for high grade industrious men and women retailing Rawleigh Products direct from manufacturer to consumer. Every home your market. Large repeat orders. Write Rawleigh's, Dept. H-65-PSC, Freeport, Ill.

ONLY two sales per day makes over \$1200.00 monthly profits. Auto tools. Every mechanic a prospect. 95% virgin. \$50.00 sales makes \$36.00 profits. New. Proven. Protected territory to producers. Year around demand. Mesco, Beaver City, Nebr.

NEW! Sensational! Push-button controlled gas tank lock. Electric—Operates from dash. Sold by Graham-Paige Motor Corporation. Greatest thing out! Write Today! Snap-Up, Ashland, Ky.

BIG money applying initials on automobiles. Write for particulars and free samples. American Letter Company, Dept. 47, Dunellen, N. J.

AFTERNOONS Free! Work home! \$2,000 month (orders) reported (exceptional case—fulltime). Expect surprise answer! National-M, BX1240, San Bernardino, Calif.

COIN Checks: Slugs, razor blades, trick playing cards, etc. Rush 10c for sample layout. Low wholesale prices to agents. De-Verre Novelty Co., Dept. 37, Dayton, Ohio.

100% PROFIT on \$1.00 Sales—Cel-O-Glaze, New cleaning-polishing product. Appoint sub-agents. Your own labels. Reliable Mfg., 48 Victoria Rd., Hartford, Conn.

WE pay you \$5 for selling ten \$1 boxes. 50 distinctive assorted name imprinted Christmas cards. Sell \$1. You make 50c. Free samples. Cheerful Card Co., 56 White Plains, N. Y.

AGENTS: Opportunity make money; book containing 127 successful business plans; home-office; send for free introductory booklet, Elite Co., 214-A Grand St., New York.

BIG money applying initials on automobiles. Easiest thing today. Free samples. Also, sideline salesmen for short order Decalcomania name plates. "Ralco," 1305 Washington, Boston, Mass.

GOOD Paying business silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures by late method. Free particulars and proofs. Gunmetal Co., Ave. G, Decatur, Ill.

FREE sample—amazing cleaner; sells homes, taverns, everywhere. Big profit—fast repeater. Besco, 5009-X, Irving Park, Chicago.

AGENTS—300% Profit selling Gold Leaf letters; stores and offices. Free samples. Metallic Letter Co., 437 North Clark, Chicago.

MEXICAN Curios sell on sight. Large profits. Free particulars. Samples 10c stamps. Marquez-IV, Apartado 1176, Mexico City.

SUCCEED with your products. Make-sell them. Formulas. Processes. Accurate analysis. Catalog Free. P. Thaxly Co., Washington, D. C.

QUICK Cash. Colored people buying new Hair dressing, bleach cream on sight. Samples Free. Valmor, 2241-AAN Indiana Ave., Chicago.

CHRISTMAS Cards. Absolutely finest assortment. Season starting. Write for samples. Robinson Cards, Dept. 604, Clinton, Mass.

BUSINESS proposition resilvering mirrors, reflectors, making chipped glass nameplates, signs. Write Sprinkle, Plater, 910, Marion, Ind.

SILVERWARE cleaned instantly. Simply dip and dry. Amazing demonstrations. 566% profits. NuProcess, Dept. 65, Aurora, Ill.

SELLING 14K Gold Cross Clasp pins is profitable. Millions will be bought. Sample 25c. Christian Alliance, 914 Jackson, Philadelphia.

SELL Mechanics Protex-Ur-Hands! 40% Commission. Excellent repeater. American, 491 William, East Orange, N.J.

WINDOW sign letters. Penny each. Large sizes. New styles. Absolutely beautiful. Free samples. Atlas, 7941-R Halsted, Chicago.

HOW and where to obtain capital. Particulars free. Star Service, Wapakoneta, Ohio.

ANTIQUES, RELICS INDIAN GOODS

INDIAN relics, Confederate bills, coins, gems, crystals, minerals, curios; catalog 52 illustrations 5c. 100 ancient arrowheads \$3.00. Tomahawk head 50c. H. Daniel, Hot Springs, Ark.

SWORDS, Rapiers, Daggers, Pistols. Catalog 10c. Robert Abels, 860½ Lexington Avenue, New York.

30 GENUINE Indian arrowheads. \$1.00. Catalog. George Holder, Glenwood, Ark.

AUTHORS' SERVICE

STORY revision, typing. FMR Services, Room 902, 1457 Broadway, New York.

AUTOMOBILES

GARAGE Owners and Mechanics only purchase direct at full factory discount Triple-X alloy self-locking piston rings. Nationally distributed. Guaranteed performance. Stops oil pumping. Saves gasoline. Re-boring unnecessary. Write for sample and details. Triple-X Co., 3801 S. Racine, Dept. 206, Chicago.

NEW Fifth edition Automobile Racing Book. Tells how to build dirt track bodies, frames, engines. Records, superchargers, rules, formula, plans, stock conversions, roadster racing, fast Fords. \$1.00 postpaid; \$1.15 C.O.D. Ray Kuns, Department 247, Madisonville, Cincinnati, Ohio.

MIDGET and motorscooter wheels, axles, forks, motors, clutches, brakes, plans, building kits, etc. Circulars free. Catalog with plans, 10c. New lists used motors, midgets, parts, 20c. Shipps Midgets, Box 543-K, Zanesville, Ohio.

SUPERCARGERS \$3.00. Guaranteed mileage increase 20%; power 10%. University of Detroit test. Any car; give make, year. Wrench installs 15 minutes. John Hanley, Manufacturer, 5719 Loraine, Detroit, Mich.

AUTO SUPPLIES & EQUIPMENT

CONVERT your car to burn Diesel oil. Save up to 70% fuel costs. Cheap installation. Wonderful performance. Proven factory method. Different and better. Costs nothing to investigate. Write for free circular No. 3. Harrington Company, 201-204 Manchester Bldg., Portland, Oregon.

BARGAINS—Welders, compressors, battery chargers, car washers. Liberal trial terms. Write Hobart Equipment, Box P-8403, Troy, Ohio.

FUEL oil conversions—For automotive, marine engines. Write for free literature. Houston & Logan, 2112 Addison, Berkeley, California.

AUTOMOBILE initials—Black on gold shields—6 for 10c. Water transferring. Master Decalcomania, Ardsley, Penna.

PUNCTURESEAL automobile tires 15c. Selfsealing. Particulars, D. Gerwin, Fairview, Okla.

MOTOR Tune-Up oil formula: Fastest money-making proposition ever offered. Schafer, 547 Melrose St., Chicago, Ill.

AVIATION

GET into Aviation! Train now at this Lincoln Aeronautical Institute for responsible position as Aeronautical engineer, air transport pilot, aviation mechanic or aircraft sheet metal craftsman. Good jobs open! Big money paid! We assist graduates in locating positions. Part time employment for board and room while in training. Write today for information. Lincoln Aeronautical Institute, (Inc.), Lincoln Airplane & Flying School Division, 2104 Aircraft Bldg., Lincoln, Nebr.

AVIATION workers are in demand. Prepare yourself by learning Blueprint Reading. Send .03c postage for descriptive booklet. Baltimore School of Aviation, Box 32, Hamilton Station, Baltimore, Md.

AIRLINER propellers, all types. Aircraft supplies. Ford A conversion diagrams with instructions, 25c. Standard Aerocraft, Ft. Worth, Texas.

AVIATION Apprentices: Air-minded Young Men interested in training for entering Aviation as Apprentices see ad on page 27.

PROPELLERS For airplanes, sleds, boats, fans, dehydrators. Catalog 10c. Banks Propellers, Love Field, Dallas, Texas.

LEARN to fly free. Folder, dime. Ohmeyer, Box 391B, Hempstead, N. Y.

BATTERIES, GENERATORS, ETC.

EDISON lifetime storage batteries for light and power. Eliminate acid battery diseases. Long guarantee. All kinds rebuilt generating plants, motors, and miscellaneous articles at bargain prices. Free interesting literature. W. Hawley Smith Company, Croton Falls, N. Y.

EDISON storage batteries for lighting and power. Non-acid. Odorless. Fifteen year life. Five year unconditional guarantees. Reasonably priced. Tremendous savings in battery and light plant combinations. Free illustrated literature. See-Jay Co., 87 Sterling Ave., Yonkers, N. Y.

BOATS, OUTBOARD MOTORS, ETC.

GENUINE new Evinrude and Elto outboard motors now as low as \$26.50 (plus small transportation charge). Down payment as low as \$6.00. Fifteen advanced 1940 models to choose from. Write for catalogs, boat directory and handy Boat-&Motor Selector—all free! Address, Evinrude Motors, 4295 N. 27th St., Milwaukee, Wis.

LEARN—Piloting, Seamanship and small boat handling at home. 266-page profusely illustrated instruction book prepared by experts especially for beginners. Easy to grasp and remember. \$2.00 postpaid. Motor Boating, 576 Madison Ave., New York, N. Y.

MARINE Power. Easily convert any Ford motor (domestic and foreign) with Osco Parts and Kits. Complete Catalogue 25c (coin). Osmithson, 3648-P Lawrence St., Philadelphia, Pa.

BUILD Electric Outboard from automobile generator. Smooth—quiet. Uses car battery. Complete plans 10c. LeJay Manufacturing, 523 LeJay Bldg., Minneapolis, Minn.

SPEEDOMETERS for Outboard boats. Two models—O-35 MPH, 10-55 MPH. \$6.95 each. Write for folder. Aqua Meter Co., 60 Glenwood Rd., Upper Montclair, N. J.

OUTBOARD Motors. Used and Rebuilt. Save money. Used parts. Bargain list free. Crandall-Hicks, 955 Commonwealth, Boston, Mass.

EASY built Kayaks—Inboards—Outboards—Rowboats. Complete kits. Free catalog. Kayak Boat, 154-A East 129th, New York.

MARINE Conversion Parts for all auto engines. Buy here and save. Conversion Parts Co., 277 Adams St., Boston, Mass.

KAYAKS. Outboards. Weldwood ready-cut kits. Catalog. Cre-Craft Boats, Dept. I, Millburn, N. J.

SAIL-MAKING kits—New easy method. Write Box 345, Torrington, Conn.

SEE our ad on Page 214. Cleveland Boat Blueprint Co.

BODY-BUILDING COURSES

EXERCISE equipment, courses. Special offers! Free booklet. Good Barbell Co., Dept. 6, Reading, Pa.

BOOKS, MAGAZINES, NOVELTIES BOUGHT & SOLD

EXCELLENT Sparetime profits taking subscriptions—2500 magazines. Agents confidential catalogue, complete starting supplies Free! Dept. 42, Pines, 583 Monroe, Brooklyn, N. Y.

LOVE Diary, Deluxe, privately printed; Now \$1. Free Prospectus. Box 146, Palisades Park, New Jersey.

BUILD IT YOURSELF

BUILD your own machine tools. Castings and Blue Prints at nominal cost. Send 10c for 2 color 28 page catalog. 34 prints covering 12 metal-working projects, \$1.50. 23 prints covering 6 wood-working projects, \$1.00. Lewis Machine Tool Co., Dept. S-8C, 2051 Santa Fe Ave., Los Angeles.

MOTORSCOOTERS, Midget cars! Easily built. Send 10c for complete plans and literature on wheels, tires, motors, transmissions, clutches, motorbike attachments, derby kits, etc. Honsaker, Masontown, Pa.

BUILD power Scooters, midget cars. We supply tires, wheels, motors. Lowest prices. Send 10c for plans, etc. Build-Your-Own Devices, Dept. 8-B, 536 North Parkside, Chicago.

SEAWORTHY 12' rowboat, construction plans, 25c. Dillabaugh, Box 1855, Portland, Oregon.

BUSINESS OPPORTUNITIES

127 WAYS to make money, in home or office, business of your own. Full particulars free. Elite Co., 214-A Grand St., New York.

PLASTEX Industries offer industrious men an opportunity to start a business of their own, manufacturing art goods, novelties and utility products in Plastex and marble imitation. ½c material makes regular 10c store seller. Rubber molds furnished for speed production. Small investment brings big returns. We are now placing big chain store orders with our manufacturers. Ambitious men have chance for real prosperity. Plastex Industries, Dept. S., 1085 Washington Ave., New York, N. Y.

MAKE artificial marble, glazed tiles, uncanny. Tabletops, plaques, floors, hones, novelties. Hard, fireproof, inexpensive, cement secrets. Brilliant tile and liquid rubber samples 3c. Latex postpaid, pint \$1.25; quart \$2.00; gallon \$6.00. Acid, and water-proof Cement Glaze (U.S.A. only) same prices. John J. Payn, 945 Grande Vista Ave., Los Angeles, Calif.

ANNOUNCING new home study course in commercial baking. Good field for ambitious men. Nearly depression proof business. Common school education sufficient. Send for free booklet "Opportunities in the Baking Industry" and requirements. National Baking Institute, 3601 Michigan Ave., Dept. 1745, Chicago.

IF you have some spare room, a basement or garage where you can do light work, we can offer you a profitable proposition casting 5 and 10c novelties, ashtrays, toy autos, etc., for firm of many years standing. No experience necessary as we furnish full instructions with moulds. A rare opportunity to devote spare or full time to profitable work. For details write: Metal Cast Products Co., Dept. E, 1696 Boston Road, New York City.

WE help start you in business, furnishing Outfits and Instruction, operating "Specialty Candy Factory" home. Men-women, opportunity to earn good steady income, all or spare time. (Our 31st year.) Booklet free. Ragsdale Candies, Drawer 14, East Orange, N. J.

START home business making statuary; plaques; art goods; novelties; souvenirs; concrete pottery; garden furniture; artificial marble flooring; liquid marble. Make your own flexible molds. Amazing profits. Valuable folder free. Creative Publishers, P.S. 8, Glencoe, Ill.

MAIL Order business course shows you how to make money, spare or fulltime. Teaches professional mail order technique—not penny-catching schemes. Free details. Nelson Co., 500 Sherman, Dept. H, Chicago.

DEVOTE your time to profitable work. A new lawn mower grinding machine operated by hand will pay for itself with one day work. Anton Wellert, 142 Gaylord Street, Binghamton, N. Y.

INDEPENDENCE for Young and Old. Write for information about Chromoscopy, color science. Applies industries, health and arts. Collins, Box 744, San Jose, Calif.

"SHARE in Success"—If you advertise or are thinking of advertising or entering the mail order business, write for this free folder. O.K. Kelly, 351 Fourth Ave., New York City.

M.M. earned \$1174 in spare time for exceptional "cellar crop" Snow-King mushrooms! Free book tells if your cellar, shed suitable. We buy crops. United, 3848 Lincoln Ave., Dept. 129, Chicago.

GOOD Paying Business silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures by late method. Free particulars and proofs. Gunmetal Co., Ave. E, Decatur, Ill.

SUCCEED with your products. Make-sell them. Formulas, Processes, Accurate analyses. Catalog Free. P. Thaxly Co., Washington, D. C.

PAINT Signs—Follow letter patterns; all sizes; use indefinitely. Trial offer—2 inch alphabet—numerals—Instructions \$1.00. R. Whitefield, North Hills, Pa.

PAINT Signs and showcards easily and expertly with letter patterns. Many sizes and styles. Write for folder. John Rahn, B1330 Central Ave., Chicago.

START Mail Order book business new way. I've made thousands yearly by it. Complete particulars free. Economy Publishers, 15-S Park Row, New York.

INVENTION Finance Magazine. 80-N Wall Street, New York. For inventors. Free particulars.

PUBLISH a magazine 25c (5 different). Publisher, 4 Grant Ave., Alston, Mass.

AFTERNOONS Free! Work home! \$2,000 month (orders) reported (exceptional case—fulltime). Expect surprise answer! National-N. BX1240, San Bernardino, Calif.

MAKE color-glazed concrete pottery, grave-stones, tiles, floors, walls. Basement waterproofing, etc. Booklet, 3c stamp. National Potteries, Minneapolis, Minn.

100% PROFIT—Cel-O-Glaze, Kleans as it polishes. Appoint agents. Your name on labels. Reliable Mfg. Co., 48 Victoria Rd., Hartford, Conn.

EASY profits. Little or no investment. Free broadside reveals secret, exclusive plans. Creative Service Bureau, Box 872-P, Milwaukee.

GET business by mail! Learn who, what, how, where-to-sell! Read Mail Order Journal. Sample 10c. 2812 S. Michigan, Chicago.

BELTS for summer sportswear, easily made. Easy to sell! No tools! Sample 25c. Artew Leather, 400 Joseph Ave., Rochester, N.Y.

RAISE Mushrooms-Ginseng for us. Material supplied. Catalogue 10c. Houck's, R-4, Tiffin, Ohio.

MONEY in flag decorating business. Small capital. Details from Wales Incorporated, 236 W. 55th St., New York.

TURN Typewriter ribbon spools into money. Profitable. Easy instructions 25c. National Specialty, Independence, Kansas.

MONEY-MAKING Opportunity. Send 3c stamp. Doctor Finn, 2602-C Gerritsen Ave., Brooklyn, N.Y.

HANDY men. Earn money home operating Community "Fit-It" Shop, Stafford, Makanda, Ill.

MOLD making, plaster casting. Foolproof rubber. 24 page instructive catalogue free. Plastic's, 711 Neely, Muncie, Ind.

RAISE Guinea pigs for us. Send quarter for book. Roberts Laboratories, Waukesha, Wis.

TURN Tin cans into money—Instructions 25c. Chaney, 1130 East 16th St., Jacksonville, Fla.

OPERATE a Collection-Credit Bureau. Very profitable. Permanent. Free Folder. Cole Association, Syracuse, N.Y.

"NEW Money Makers"—Big Mailorder Magazine-10c. K. Marvin, Publisher, 330 South Wells, Chicago.

WHERE to buy at lowest wholesale prices. Information free. Yorena, Box M-312, Bayonne, N.J.

RUBBER-Mold making. Plaster casting. Instructions 25c. Kemikon, 179, Parkridge, Ill.

HOW and where to obtain capital. Particulars free. Star Service, Wapakoneta, Ohio.

BUSINESS SERVICE

"SHARE in Success"—If you advertise or are thinking of advertising or entering the mail order business, write for this free folder. O.K. Kelly, 351 Fourth Ave., New York City.

FOREIGN, Domestic Mailing Lists. Millions of names. State your needs. Q service, 330 S. Wells, Chicago.

CAMERAS, PHOTO SUPPLIES

WRITE Bass for any and all camera wants—new and used Still and Movie equipment of all kinds—typical bargains: Slightly used Argus model A:F:4.5 lens, \$5.75; Univex -8 Movie with F:5.6 lens, \$4.45; Used Speed Graphic, F:4.5 lens, Compur shutter, \$57.50; Leica model A, F:3.5 lens, \$37.50. Send for your free copy of Bass Bargaingram. 2 editions Still or Movie. State preference. Mention Dept. SP, Bass Camera Co., 179 W. Madison St., Chicago, Ill.

AMATEUR Photographers attention! Improve your hobby of picture taking and learn how to make money with it. Write today for our 40-page book catalog and a sample copy of American Photography, enclosing ten cents for postage. Contains articles and pictures of the world's foremost writers and pictorialists. Camera House 141, 353 Newbury St., Boston, Mass.

NEW instant checks record all negative and print data, fast, simple. No writing, just check. Fits vest pocket. Selling like hotcakes. No. 1 Looseleaf 40c, refills 25c. File with negative. No. 2 book 25c at live camera stores or direct postpaid. Superior Products Co., 861 Lincoln Ave., Evansville, Ind.

ENLARGER \$1.59. Enlarges eight times size of small negatives. Guaranteed. Paramount Sales Company, 89 Dudley St., Boston, Mass.

OIL coloring photographs a fascinating hobby or profitable business. Learn at home by easy simplified method. Previous experience unnecessary. Send for free information and requirements. National Art School, 3601 Michigan Ave., Dept. 174C, Chicago.

FREE! New Camera Catalog "P. S. 5". (All types). Bargains on all cameras and supplies. Extra savings on Leicas, Perflex, Reflex, Argus, Kodak Cameras. Write us! We are "Serving the Nation from the Nation's Capital". Brenner Photo Co., 943 Pennsylvania Ave., N. W., Washington, D.C.

MAKE money in photography. Learn quickly at home. Easy plan. Previous experience unnecessary. Common school education sufficient. Interesting booklet and requirements free. American School of Photography, 3601 Michigan Ave., Dept. 1742, Chicago.

SPEED-O-COPY groundglass focusing attachment for Leica and Contax. Send for literature. D. Paul Shull, Dept. PS7, 240 S. Union, Los Angeles.

CAMERA Repairing. Bellows made to order, shutters repaired. Bellows made to fit, all standard cameras! United Camera Co., Inc., B-1515 Belmont, Chicago.

FREE—Chrome plated "Framette"—the all size picture frame. Get details at once. Ganz Co., Dept. 8, 112 No. Hayworth Ave., Hollywood, Calif.

CAMERAS! Trades accepted. Investigate! McKinley's, 87 Alexandrine East, Detroit, Mich.

20% TO 40% discount on films, paper, still or movie cameras. Write: Paramount Co., 327-PS, East 92nd St., New York.

"More Business"—

We have been advertising in your magazine for almost two years and take this opportunity to congratulate you on the results which your ads have brought us.

We have found that constant advertising in Popular Science has well paid for itself and we have found that each dollar spent on advertising with you has brought us more business than any other publication.

R. & S. Engineering Co.,
New York, N. Y.

CARTOONING, SIGN PAINTING, DRAWING AIDS

AMATEUR Cartoonists, earn steady income copying cartoons for advertisers. Adservice, Argyle, Wisconsin.

CHALK TALK STUNTS

LAUGH producing program, \$1.00. Illustrated catalog 10c. Cartoonist Balda, Oshkosh, Wis.

CHARTERS

DELAWARE charters; complete service \$35.00. Submitted forms. Chas. G. Guyer, Inc., Wilmington, Del.

CHEMICALS & APPARATUS

CHEMISTRY Laboratory apparatus and chemicals for industrial, analytical, and experimental laboratories. Complete supply service for students taking correspondence school chemistry courses. Send 3c postage for free 44 page catalog. Dept. M26. Biological Supply Co., 1175 Mt. Hope Ave., Rochester, N.Y.

CHEMICAL bottle opener. Removes frozen stoppers easily and safely. \$1.00 Postpaid. Midland Specialties Co., Dept. P2, Midland, Penna.

CHEMISTRY Courses (slightly soiled) at bargain. Particulars. B. Shapereau, 620 E. 8th St., Brooklyn, N.Y.

SPECTROSCOPE for quick chemical analysis \$2.50. McCutting Sons, Campbell, Calif.

HANDBOOK for Chemical Experimenters, illustrated, hundreds of experiments, 50c. Experiment booklet, 15c. Chemical catalogue, 5c. Reading Scientific Company, Reading, Penna.

FREE: 40 page catalog of chemical and laboratory supplies for amateur chemists, Wollensak microscopes and supplies, scientific books at big discount. J. C. Winn, Dept. JC-8, 124 West 23 Street, N. Y. C.

FREE Chemistry catalog. Supplies at 5c. Equip complete laboratory. Kemkit Scientific Corporation, 397B Bridge St., Brooklyn, N.Y.

CHEMICALS in 5c quantities. Catalog 5c. Fleischer's Laboratories, Medford, Mass.

DOGS, BIRDS, PETS

PUPPIES! All breeds! Reasonable! Information Free! Book 104 photos, descriptions 25c. Royal Chazy, N.Y.

RAISE Canaries for us. Stock supplied. Catalogue list 10c. Houck's Supply, Tiffin, Ohio.

LIVE Horned toads; excellent pets, harmless. 50c each. Fred Simpson, Matador, Texas.

EDUCATIONAL & INSTRUCTION

WELDING—Electric Arc. Learn quickly by actual practice at Hobart Welding School. Individual instruction at bare cost of materials used. 50c in stamps brings valuable welding lessons post paid and full particulars. Hobart Welding School, Box P-8405, Troy, Ohio.

MEN wanted. Auto-Diesel Mechanics. We pay your railroad fare to Nashville. Let us train you to be an expert mechanic and help you get a good job. The cost to you is small. For free booklet write Nashville Auto-Diesel School, Dept. 269, Nashville, Tenn.

REAL Jobs open. Equip yourself by learning auto, Diesel, Aviation, mechanics, welding, body & fender quickly! Real opportunity for real job. Write nearest school for low tuition rates. Information Free. Dept. M-3, McSweeney, Kansas City, Missouri, or Detroit, Michigan.

CORRESPONDENCE courses and educational books, slightly used. Sold. Rented. Exchanged. All subjects. Satisfaction guaranteed. Cash paid for used courses. Complete details and bargain catalog free. Nelson Company, 500 Sherman, Dept. H, Chicago.

U. S. Gov't. jobs pay up to \$40, a week to start. Get ready for next examinations; railway postal, rural carrier, mail carrier, office help and others. Free book tells how you may qualify. Write quick. Patterson School, Dept. P. S., Rochester, N.Y.

AIR Conditioning—Electric Refrigeration. Rapid growth creates big demand for trained men. Earn up to \$35-50 weekly. Write for Free facts. Utilities Engineering Institute, 404 North Wells, Dept. 308, Chicago.

USED Correspondence Courses and educational books sold or rented. Inexpensive. Money-back guarantee. Write for free catalog listing 4000 bargains. (Courses bought.) Lee Mountain, Pisgah, Ala.

\$105-\$175 month. Men-Women. Get U. S. Government jobs. Try next announced examinations. Particulars free. Franklin Institute, Dept. F35, Rochester, N.Y.

GOVERNMENT Jobs. Men, women. Start \$105-\$175 month. Pay for course after appointment. National Institute, Dept. C, Creston, Iowa.

LEARN to operate Gas-Diesel shovels, draglines, clamshells, cranes, at home. Get big pay-checks. G. W. Sjoboen, 440 South 96, Tacoma, Wash.

CLAIM Adjusting. Excellent pay. Investigate tragic accidents, fires; outwit fraudulent claimants. Burns School, 311 Morewood, Pittsburgh, Pa.

PHOTO Engraving—Modern method, without expensive equipment. Imagic, Bristol, Tenn.

LEARN Auto Finance business. Complete Course \$5.00. Free particulars. Nebraska Finance Co., Lincoln, Nebr.

AVIATION needs draftsmen. Learn at home. Davison Technical School, East Grand Ave., Detroit.

ELECTRICAL SUPPLIES & EQUIP.

FLUORESCENT AC Daylight lighting for desk; office; windows; home. Latest sensation. 50% Discount; literature Free. McGee Radio, E-20, Kansas City, Mo.

AUDEL'S Handbook of Electricity. For Engineers, electricians, students and all interested in Electricity. A quick, simplified, ready reference, giving complete instruction and practical information. Easy to understand. A reliable authority and a Handy Helper that answers your questions. 1340 pages. 2600 Illustrations. Price \$4.00. Postpaid. Money back if not satisfied. Theo. Audel, Publishers, 49 West 23 St., New York.

ALTERNATING Current Bargains. 1/2 horse, 3450 speed, repulsion induction motors \$10.50, 500 watt, alternating generators \$22.50. Butler Electric Co., 1885 Milwaukee Ave., Chicago.

HEALTH Lamp: Dual Ray—Ultra Violet Infra Red. Promotes Sun-Tan Vitamin "D". Automatic AC-DC current, \$3.90. Details, Beyer Mfg., 4515-C Cottage Grove, Chicago.

ENGINES, MOTORS, ETC.

BARGAIN 1/2 HP. rebuilt motors, 60 cycle, 1 phase, 110 volt, 3600 rpm., like new, guaranteed, \$8.25. Send check to Erie Electric Motor Co., 120 Church St., Buffalo, N. Y.

COMPLETELY revised enlarged pricelist. Motors, grinders, drills, fans, home workshop tools. Mailorder Electric, 705 South Dearborn, Chicago.

BARGAINS—Welders, electroplating, motor generators, guaranteed, liberal terms. Write Hobarts, Box P-8404, Troy, Ohio.

ALTERNATING, 1/2 horse, 110 volt, induction motors. Guaranteed, \$7.25. Wilmet Auto Supply, 2247 St. Paul Ave., Chicago.

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YOU get one 5"x7" silk enlargement. Send negative—10c. Rapid Studios, Box 123-E, Villa Park, Ill.

ROLL developed—enlargement and 16 guaranteed prints, 25c. Dick's Photo, Louisville, Ky.

ROLL Developed—16 guaranteed prints, two coupons on enlargements, 25c. Smart Photo, Winona, Minn.

BEAUTIFUL Enlargement from each picture on roll 25c. Cut Rate Photos, Dept. A-6, Janesville, Wis.

75c—36 EXPOSURES 35mm Fine Grain developed and enlarged. Graphic Photos, Gardner, Mass.

TWO sets enameled prints, 2 Free enlargements every roll—25c. Lifetone, F-27, Des Moines, Iowa.

LOOK! Sixteen sparkling neverfade prints per roll, and valuable enlargement coupon, 25c. Modern Studios, LaCrosse, Wis.

SNAPSHOTS—Roll finished 2 prints each 25c. Speedy Service, Box 64, Wilkes-Barre, Pa.

5x7 ENLARGEMENTS 10c from your negatives. Film Service, Catlin, Ill.

16 OVERSIZE Deckled prints from roll 25c. Owlphoto, Weatherford, Okla.

PRINTING, MULTIGRAPHING, MIMEOGRAPHING, LABELS

125 8 1/2"x11 TWENTY pound Bond letterheads and 125 envelopes \$1.00 postpaid. Benneville, 907 West Roosevelt, Philadelphia.

HAMMERMILL letterheads, any color, envelopes matching; 30 styles type. Free particulars. Woodruffs', 217-D, Duluth, Minn.

PRINTED Correspondence stationery, 200 sheets, 100 envelopes, \$1.25. Weston, 607—8-So., Seattle, Wash.

500 TWO-Color stickers 50c. Samples. McCloy Printery, Shamokin, Penna.

PRINTING Bargains and samples. State business. Sicoan, 2038 Obear, St. Louis.

PRINTING OUTFITS & SUPPLIES

PRINT your own cards, stationery, circulars, advertising. Save money. Easy rules furnished. Print for others, big profits. Junior outfits \$8.25, senior outfits \$16.55 up. Details free. Kelsey Presses, H-8, Meriden, Conn.

HAND presses, type and complete printers supplies. Send stamp for new 52-page catalog. P. Peiffer & Company, 4 Columbia St., Newark, N. J.

INEXPENSIVE 6x9 printing press. Details Free. Novelty Shop, Downsview, La.

PROFITABLE OCCUPATIONS

RAISE Rabbits and Cavies for us. Full details. Catalog, contract and magazine 10c. Or send 25c for book, catalog and year's subscription to Small Stock Farmer Magazine. Stahl's, Box 11, Holmes Park, Mo.

M. M. earned \$1174 in spare time for exceptional "cellar crop" Snow-King mushrooms! Free book tells if your cellar, shed suitable. We buy crops. United, 3848 Lincoln Ave., Dept. 131, Chicago.

AUTO Body and fender work—Learn at home in 4-6 weeks; important trade with good money-making opportunity. Atlantic, 718-23rd Ave., Oakland, Calif.

POSITIONS abroad—How and where to apply for them. Julius, Amarillo, Texas.

RADIOS, SUPPLIES & INSTRUCTION

RADIO engineering, broadcasting, aviation and police radio, servicing, marine and Morse telegraphy taught thoroughly. All expenses low. Catalog free. Dodge's Institute, Poplar St., Valparaiso, Ind.

RADIOS—\$7.95 up; kits—\$3.95 up. Complete. Ready to wire, 5-10 tubes. Save 50%. Catalog—Free. User agents wanted. Marco-EP, Kansas City, Mo.

REPAIR your radio yourself—Expert diagnosis and directions—50c. Radio Clinic, 1327 W. 112th, Cleveland, Ohio.

LARGE stock used Radios. Dealers investigate. Maxs, 606 Maxwell, Chicago.

RARE COINS

FREE! Foreign coin, banknote, and large illustrated coin catalogue. Send 4c postage. Coin approvals sent. Tatham Coinco, Springfield-D50, Mass.

COMMEMORATIVE \$1½. Columbus, Lincoln, Stone-Mountain, Cleveland, \$1.00 each. Retail catalogue 10c. Norman Shultz, Salt Lake, Utah.

WE purchase all Indianhead pennies. Purchasing catalogues 10c. Addis Waltman, 398 Broadway, New York.

RETAIL Coin catalogue with 2500 quotations 10c. James Randell, 37 West Van Buren, Chicago.

FREE coin list for .03 stamp. Gaylord Coin Co., 5316 Dorchester Ave., Chicago, Ill.

COLLECT Coins for pleasure and profit. Coin Catalogue—10c. Eugene Morrison, Reseda, Calif.

RUBBER STAMPS

CUSHIONED. 2 lines 25c. 3-35c. Ours are better! Ad-Crafts, LaCrosse, Wis.

SCIENTIFIC INFORMATION

STROBOSCOPE. Stops motion. Manufactures, laboratories, schools, shops. Free literature. E. A. Schlueter, 3382 Sixty-second Ave., Oakland, Calif.

SONGWRITERS

WANTED: Original poems for musical setting. Publication, radio, recording service. Richard Brothers, 146 Woods Bldg., Chicago.

WANTED. Poems, to be set to music. Submit for consideration. Transcription records made. Keenan's Studio, PS, Box 2140, Bridgeport, Conn.

ORIGINAL poems, songs wanted for immediate consideration, publication. Music Corporation, Dept. N-16A, Portland, Ore.

SONGS and poems wanted. No charge for melodies. Monthly awards. Hollywood Recording Studios, Box 87LP, Preuss Sta., Los Angeles.

FREE inspiring booklet describing song-writing opportunities. Allied Music Dept. 5, Box 507, Cincinnati, Ohio.

SONG Poems wanted. Free examination. McNeil, Master of Music, 510-PS South Alexandria, Los Angeles, Calif.

PIANO Parts to three poems \$18.00. Songland, "40PSM8", Thomaston, Maine.

SPORTING GOODS, GUNS, FISHING TACKLE, ARCHERY

GUNSMITHING. Restocking Guide (24 pages). Free. Invaluable for amateur, professional gunsmiths, Home craftsmen, shooters; Exclusive, complete information, illustrations, Walnut stocks, Blanks, gunsmith tools, remodeling, actions, blueing, checking tools. Limited supply. Write America's Great Gun House, Stoeger Arms Corp., 507 Fifth Ave., New York, N. Y.

ARCHERY: Ideal sport and recreation. Complete instruction book, 50c. Catalog free. Chester Brown, 617 South State, Chicago.

HUNTING, fishing, trapping, outdoor equipment, used guns: List and catalog free. Howe Fur Company, Coopers Mills, Maine.

ARCHERY Kits complete, everything that's needed. Catalog, Krons-Noble Co., 910 43rd St., Kenosha, Wis.

TENNIS Restrainers: frames, gut, silk. Free catalog. Tennis Supply, 1407½ Sixth Avenue North, Minneapolis, Minn.

STAMP COLLECTING

55 SENGHOR, Bolivia, Ecuador, Palestine, Egypt, etc. Approvals 5c. Libby Stampco, Station P, Box 43-E, Brooklyn.

GIANT packet 200 all different from Africa, South America, Asia, South Sea Islands, etc. Includes world's smallest stamp; triangle and diamond-shaped stamps; animal stamps. Nicaragua "Will Rogers" airmail; many others. Also packet 17 different United States (cataloging 50c); all obsolete, including \$4 denomination, commemoratives, etc. Total catalogue price over \$5.00! Everything for only 5c to approval applicants! Mystic Stamp Company, Dept. 55-N, Camden, New York

FREE! The Stamp Finder! Send today for big new edition, fully illustrated, enabling you instantly to identify all difficult stamps! Also fine packet strange, fascinating stamps from Bosnia-Herzegovina, Monaco, Patiala, Cyprus, etc., including maps, ships animals and strange scenes. All free to approval applicants inclosing 3c postage. Garcelon Stamp Co., Box 918, Calais, Maine.

NEJD (Arabland), Bolivia triangle, Caymans, Negri Sembilan, Turks Caicos, Manchukuo, Bahamas, British Solomons (Cannibaland). Everything 3c with approvals. Viking, 130-P Clinton St., Brooklyn, N. Y.

SCARCE Diamond airmail! Wonderful packet 115 different from strange countries. British Colonies, Haiti, Tasmania, pictorials, etc. 5c to approval applicants. Reliable Co., Dept. 8, Box 139, Church Annex, New York.

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STAMP Magazine free—Breezy, authoritative, articles on new issues, questions and answers, philatelic subjects. Sample copy Philatopic Monthly free. Empire Stamp, Dept. P.R., Toronto, Canada.

THIS Ad gets attention! So will yours—if you use White Space as shown here. Added cost is low! For details, write to Classified Adv. Mgr., Popular Science Monthly, New York, N. Y.

UNITED States stamps on approval. 1500 different in stock, including old issues, commemoratives, airmails, revenues, etc. Write for selection. Southern Stamps, Drawer 70, Miami, Fla.

FINE approvals, freshly filled books and sheets. Tell me what you want and I will send them. Milton Skinner, 306 East Fourth, Long Beach, Calif.

200 DIFFERENT. 5c! Includes worldwide variety, scenics, commemoratives, airmails, pictorials. Approvals. F-S Company, Box 2154, Houston, Texas.

15 WILD Animal stamps from diff. countries and 2 triangles from Mozambique 10 cts.—approvals. Dave Wyckoff, 3811 Ash, Detroit, Mich.

UNPICKED mixture: 40c pound! 100 U. S. revenues on documents—10c! (700—50c). 1,000 Canada—35c. Vanvoorheis, Hyndman, Penn.

57 DIFFERENT U. S. Gauge, hinges!—9c! Approvals. Autostamps, Box 83, Linwood Station, Detroit.

MEXICAN \$20 bill and 100 different foreign stamps 10c. Nagles, 346 North 12th, Reading, Penna.

EUCARISTIC triangle and set of Andorra 3c with approvals, Cooperman, Hayti, Mo.

1940 WHOLESALE catalogue Free—Eighty pages. Empire Stamp, Dept. 19, Toronto, Canada.

140 SUDAN, Palestine, Bolivia, Norway, Peru, Ecuador, etc. 10c. Lufbery, Middletown, Conn.

PANAMA Bargain Packet: 115 different including 15 Panama, Canal Zone, 25c with approvals. Leo Marchosky, David, Panama.

EXCHANGE your duplicate stamps. List, Swappers, dime. Registrar, Box 2166, Denver, Colo.

FREE! Two coronation sets. Postage 3c. Roberts, 312U Shearer Bldg., Baycity, Mich.

FREE! 50 different Belgium. Postage 3c. Approvals. Official Stamps, Fairlawn, N. J.

NINETEENTH Century United States, 15 different, 10c. Goldsmith, Box 200-R, Chicago.

UNITED States stamps on approval—Big discounts. Stamp Company, Broadway, Albany, New York.

50 LARGE French Colonials, 3c. approvals. Kravat Company, 1925-P Quentin Rd., Brooklyn, N. Y.

U. S. Parks complete 19c Better grade Approvals. Box 488A, Minneapolis.

FREE! Austria war set. Postage 3c. Williams, 601 Archerbldg., Baycity, Mich.

TEN sets French Colonials, 10c. Approvals. Box 14, Wilton, N. H.

72 DIFFERENT U. S. 10c. Album Service, Route 57-10, Sioux City, Iowa.

FREE Premium to approval applicants. Dixie Stamp Company, Americus, Ga.

PENNY Approvals by country. M. H. Hoerning, Merriam, Kansas.

THREE Triangles free with approvals. Chester, Box 545-V, Utica, N. Y.

SOUTH American—100 different 10c—with approvals. Davis, Silver Lake, Ind.

10 COMPLETE sets 10c with approvals. Midwest, 2241-K East 71st, Chicago.

LATIN America—35 different 5c. approvals. Ransom, 1333 Pontiac, Ann Arbor, Mich.

THREE sets for 3c stamp! Jack Reed, Jr., Houtzdale, Penna.

FREE! Zeppelin airmail set complete with approvals. Riedell, Greensburg, Penna.

NUDE Duchess Set (two), 5c. Approvals. Laurence Shultes, Berne, N. Y.

PENNY Approvals that satisfy. Neil Gronberg, Box 5441S., Philadelphia, Penn.

20 MEXICO 3c with approvals ¼c up. Josip Babcock, St. Joseph, Michigan.

500,000 STAMPS! General line approvals. Peterson, Box 31, St. Paul, Minn.

TATTOOING SUPPLIES

TATTOOING. Engraving. Outfits. Illustrated list free. Percy Waters, Anniston, Ala.

TYPEWRITERS, OFFICE DEVICES

TYPEWRITERS, adder, mimeograph, multigraph, addressograph. Send for free lists of machines that will help you at half price. Pruitt, 28 Pruitt Bldg., Chicago.

WANTED—MISCELLANEOUS

CASH for used microscopes, binoculars, slide rules, drawing sets, scientific instruments, tools, cameras. Satisfaction guaranteed or shipment returned. Elman's, 108-PS South Clark, Chicago.

WILL buy your unused United States stamps. Small discount. What have you? Mint Sheet Brokerage Co., 423 Caxton Bldg., Cleveland, Ohio.

WATCHES

WATCH-REPAIRING is steady profitable work. Experts usually in demand. You can learn watchmaking trade at home, spare time. New original instruction system. Script engraving course included. Write for free details today! Nelson Company, 500 Sherman, Dept. H, Chicago.

WATCHMAKERS' Materials—tools; watches; jewelry. Bought, sold, exchanged. Best prices for old gold, diamonds. Ben Segal Company, Mellers Bldg., Chicago.

WELDING, SOLDERING

EMERGENCY Arc-welding via storage batteries, plans 10c. Welders Club, WB-3432 M-Mart, Chicago. For Sale: Arc-welder plans \$1.00 each for Dodge generators. Vehicle motors, Light plant generators. Complete accessories. Supplies, books, vehicle motors, etc.

75-200 AMPERE Welders from old generators. Complete plans 35c. Plans show single and dual welder connections. LeJay Manufacturing, 323 LeJay Bldg., Minneapolis, Minn.

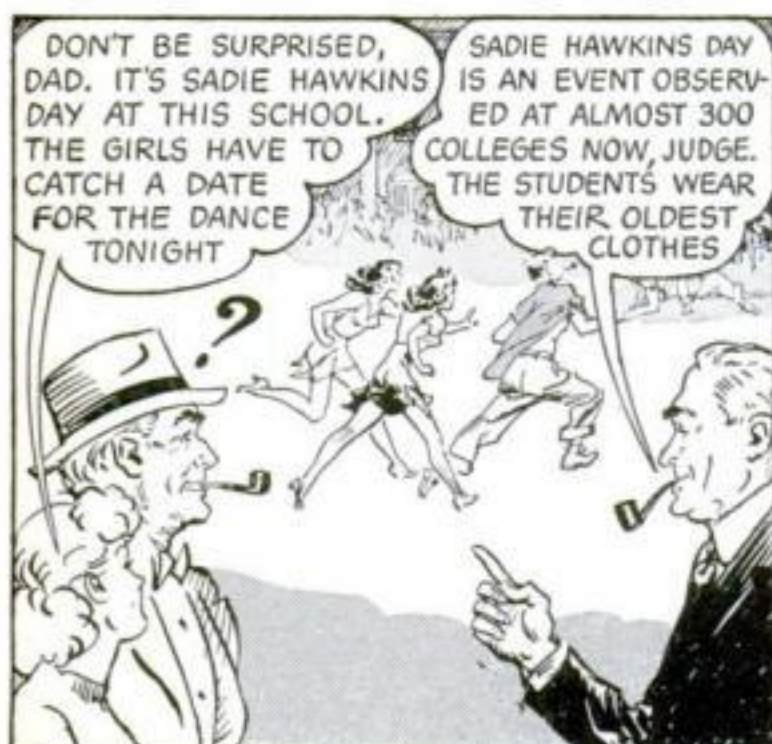
BUILD 200A A-C welder for \$10. Others cost less—no winding. Plans \$1.00. Information dime. Hi-Point Electric Products, Bellefontaine, Ohio.

BARGAINS. Demonstrator Arc Welders, gasoline and electric drive. Liberal trial, easy terms. Write Hobart Welder Exchange, Box P8402, Troy, Ohio.

110-220 VOLT arc welders, helmets, plans, material. Holgerson, Canton, Kansas.

WELDERS, new and used. Write Lincoln Electric Company, Cleveland, Ohio.

OL' JUDGE ROBBINS



IN RECENT LABORATORY "SMOKING BOWL" TESTS, PRINCE ALBERT BURNED

86 DEGREES COOLER

THAN THE AVERAGE OF THE 30 OTHER OF THE LARGEST-SELLING BRANDS TESTED—**COOLEST OF ALL!**



GRADUATE TO THE CIRCLE OF SMOKING JOY!

TRY PRINCE ALBERT FOR A NEW DEGREE OF BITE-FREE, EASY-DRAWING SMOKING!

GREET THE WORLD WITH THAT P.A. SMILE. P.A. PACKS RIGHT—HELPS A PIPE CAKE UP BETTER

PRINCE ALBERT GETS HIGH HONORS FROM ROLL-YOUR-OWNERS, TOO. SPINS UP FASTER, EASIER, SMOOTHER!

50 pipefuls of fragrant tobacco in every handy tin of Prince Albert

PRINCE ALBERT
THE NATIONAL JOY SMOKE

Copyright, 1940
R. J. Reynolds Tob. Co.
Winston-Salem, N. C.

For your convenience...

Last month POPULAR SCIENCE MONTHLY inaugurated a brand-new arrangement of its editorial pages. To make it easier for you to find the material that interests you most, the pages now are grouped according to their subject matter. In this issue, this new system is made even more useful by the addition of easy-to-read subject titles at the bottom of each page. This month also brings you a new and greatly enlarged Automobile Department. Please let us know if you like this new arrangement.

RAYMOND J. BROWN, *Editor*

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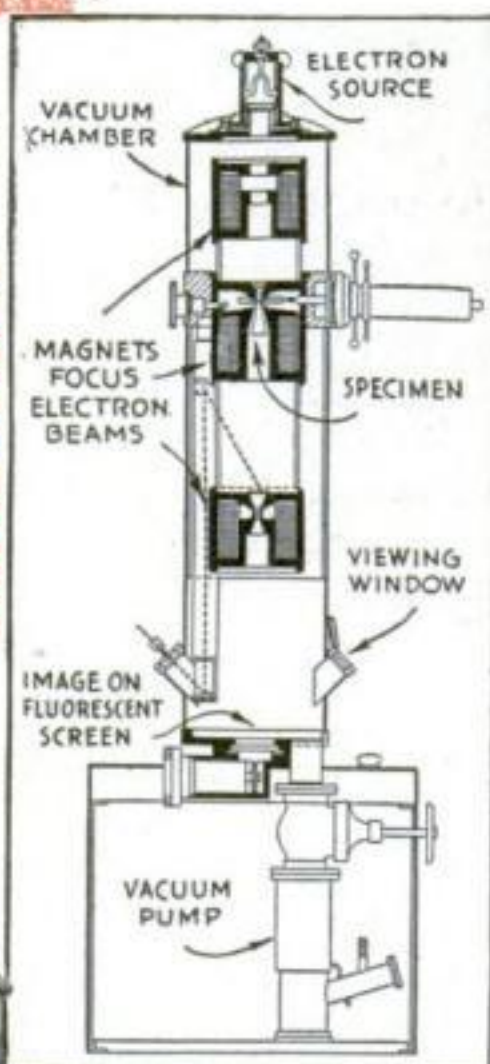
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New Wonders

ELECTRONS—those invisible electrified particles that whirl like the stars of our solar system in every atom of matter—are performing hundreds of amazing new tasks in science and industry. By modern electrical wizardry, they are being

made to do everything from opening garage doors and sorting dried beans to aiming the big guns on our first-line battleships.

For more than thirty years, ever since the invention of the modern electron-producing vacuum tube in 1906 by Lee De Forest, these tiny bundles of electrical energy have been making our lives happier and more comfortable. First came radio with its electronic detectors and amplifiers, then talking pictures with their



Dr. Ladislaus Marton with the powerful new electron microscope. Below, photomicrograph of streptococci made by the new instrument



from Electrons

By **ROBERT
E. MARTIN**

powerful vacuum-tube amplifiers, then television with its picture-producing cathode-ray tube, and now the vast new field of modern electronics. Thus, stemming from the development of the vacuum tube in which electrons streaming from a wire filament form an electricity-conducting bridge that can be made to control all sorts of electrical apparatus, the field of electronics has grown into a major branch of our vast and expanding electrical industry.

Just a few days ago, the Camden, N. J., laboratory of the Radio Corporation of America announced the newest of these electrical marvels—an electronic microscope capable of bringing into view minute specimens more than forty times smaller than the smallest visible under any conventional instrument. With it, science may soon view objects so small that they never before have been seen by the human eye.

Employing streams of electrons instead of beams of light, and electrically energized magnets instead of lenses, the \$18,000 instrument resembles a giant metal vacuum tube. Streaming down from the upper end of its ten-foot cylindrical barrel like rays of light, beams of electrons produced by an electrically heated filament are focused on the specimen to be magnified. Then, passing through electromagnets which deflect them just as lenses bend rays of light, the electrons strike a fluorescent screen at the bottom of the microscope. This bombardment causes the screen to glow like the viewing screen of a television receiver and produces in visible light an enlarged image of the tiny specimen under study. By regulating the strength of the magnets and the flow of electrons, the operator can control the magnification so that objects may be



Electrons also made possible this electric eye for measuring ultra-violet light. Among other uses, it will aid new studies of the sun

either photographed or studied visually.

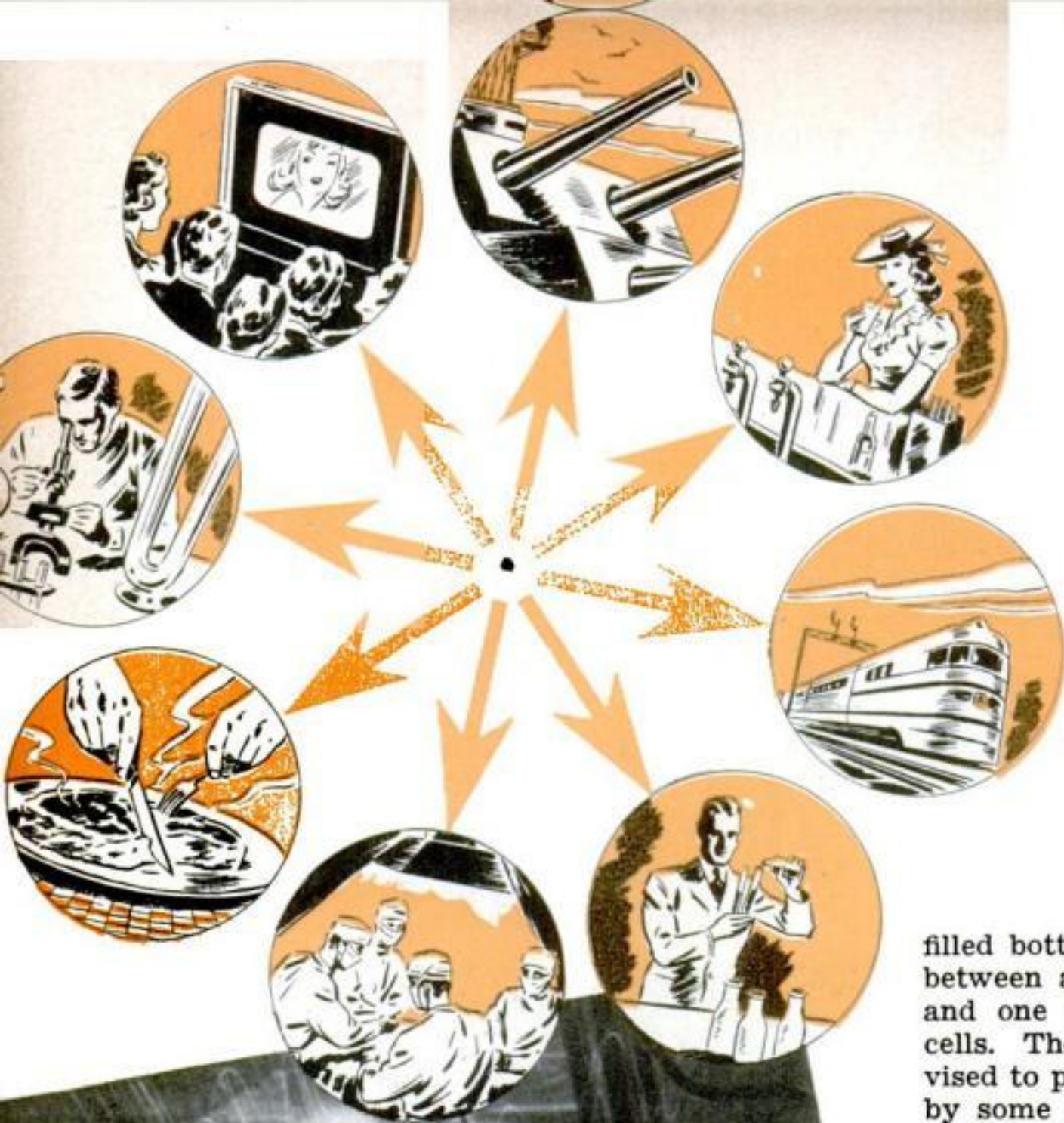
If you have ever visited the Pennsylvania Station in New York City you probably have noticed the swinging doors that open as if pulled by some unseen hands when you approach them. Similar doors are used in restaurants and many public buildings. Electrons are the unseen hands that operate these doors. In approaching them you intercept a beam of light aimed at a magic-eye tube and a stream of electrons within the tube serves as a valve to feed electricity to motors geared to the doors.

The ability of these photo-electric tubes, as the magic eyes are called, to react to light has made them one of the most versatile electronic servants to come from the laboratory. Among their varied tasks in industry is sorting raisins and other fruits, counting logs at paper mills, switching on lights at airports, and testing breakfast food by its color. One of their newest feats is operating huge highway advertising signs which flash on at night automatically when they are struck by the headlights of an approaching car.

A recent demonstration in an Eastern bottling works illustrates the amazing sensitivity of these electron-operated eyes. Moving along a conveyor, 100,000 beverage-

JOBS FOR WORLD'S SMALLEST WORKMEN

The little black dot in the center of this drawing contains billions of electrons. Though relatively inactive, when science puts them to work they perform amazing tasks. They give us radio and television (1), aim the big guns of warships (2), help bottle soda pop (3), aid in building high-speed trains (4), check the purity of milk (5), help doctors by killing germs (6), make meats tender (7), and provide powerful new tools for the research scientist (8)



filled bottles passed in single file between a tiny electric spotlight and one of these light-sensitive cells. The system had been devised to prevent any bottle which by some accident contained foreign matter from passing through to the packing room. To test the installation, an attendant placed a single eyelash in one of the bottles. One by one the bottles moved along, but when the container with the eyelash reached the robot inspector it was kicked to one side. The electric eye, reacting many times faster than you can wink your own eye, had spotted the lone eyelash and tripped a mechanical arm that rejected the bottle!

What promises to be one of the most elaborate electric-eye installations of this kind in the world will help to control automobile traffic in the new East River tunnel now nearing completion in New York City. Electric eyes placed at each end of the underwater tube will automatically subtract the number

Flash welding, used widely in industry, depends on voltage-control tubes in which the tiny electron plays a leading rôle



of cars leaving from the number of cars entering and indicate on a dial just how many machines are in the tunnel at any one time. Thus the policemen in charge will know minute by minute when to speed up traffic and when to slow it down. Other light-sensitive tubes will guard against accidents by switching on street lights when dusk approaches, by regulating the lighting within the tunnel to match that outdoors, and by sounding a warning bell whenever a vehicle nears the tunnel with a load too high to enter.

But counting cars and inspecting beverage bottles are only a few of the jobs that modern science is delegating to electrons. In a novel sterilizing lamp developed by Dr. Harvey C. Rentschler of the Westinghouse Electric and Manufacturing Co., these tiny electrified particles stream through a glass tube to produce bacteria-killing ultra-violet rays. In his laboratory, I saw small microorganisms literally explode and die when struck by the black light of the lamp.

Installed in bakeries, hospital operating rooms, and biological laboratories where vaccines are prepared, these ultra-violet tubes virtually eliminate all germs from the air. In butcher-shop refrigerators and meat-curing rooms, they prevent decay and, by making it possible to raise the temperature without spoilage, they reduce the time required to tenderize meat from five weeks to three days.

In other fields, recent advances in electronics cover a wide range. X rays, using faster films and more powerful tubes, now record split-second candid-camera snapshots of organs in action. Electrical welding has received added precision and control through the development of almost-human electronic operating mechanisms. Television, through the perfection of better and better tubes, has increased its range from fifty to 150 miles.

At the Schenectady, N. Y., laboratories of the General Electric Co., electrons have made possible a revolutionary machine that weighs by color—an electronic scale so sensitive that it can accurately give the weight of metallic particles so infinitesimal

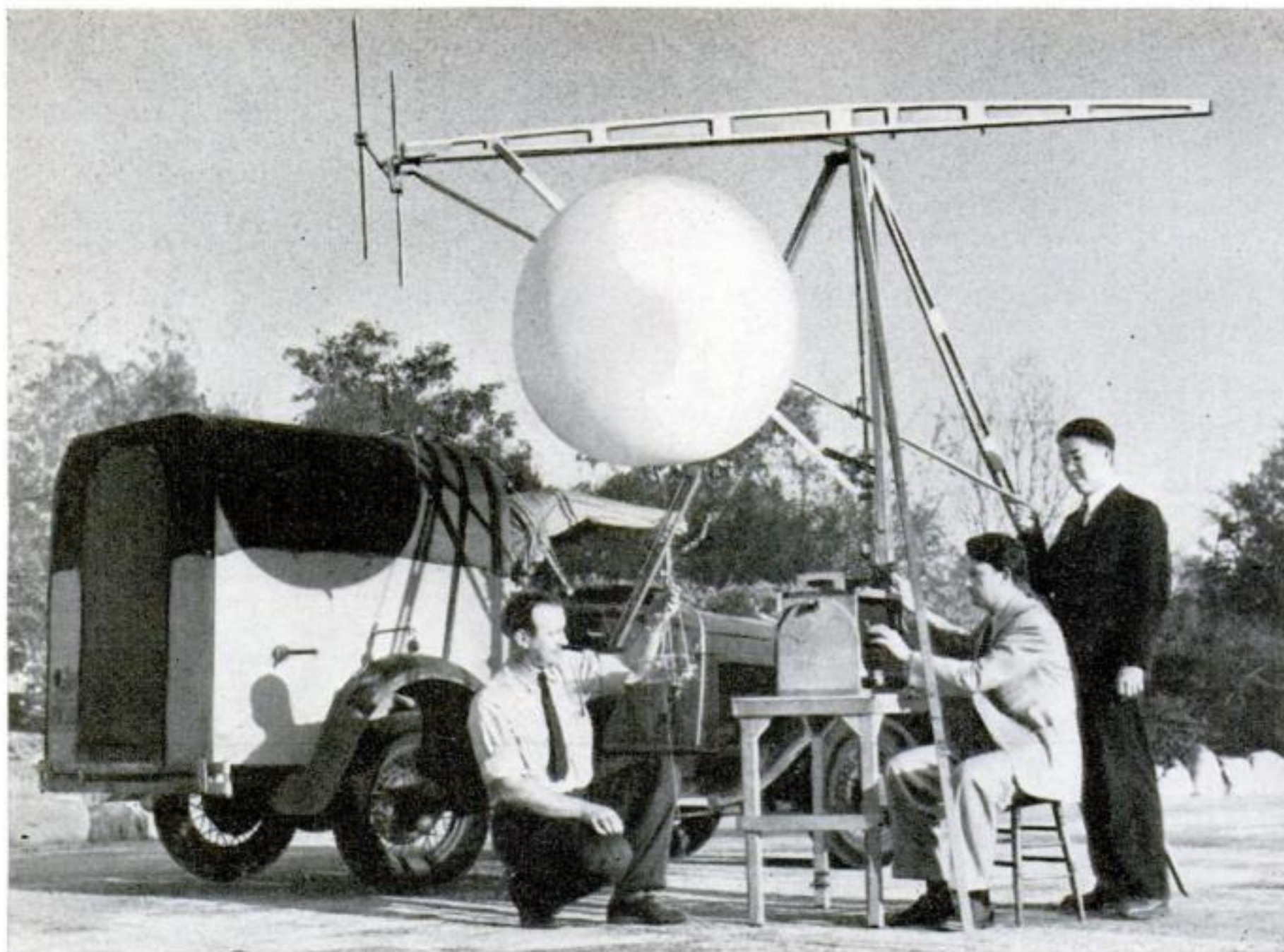
that they are 100,000 times too small to see.

Consisting of a series of photo-electric tubes and a dozen lenses, the amazing machine registers the color changes in chemical solutions as the metallic particle is added. The degree of color change depends on the amount of metal and, although the alterations in the hue are far too slight for the human eye to note, the electronic brain detects them and gives an accurate record of the indicated weight. Already this technique has been worked out for some twenty of the commonest metals and the list is rapidly being expanded.

Thus, with electrons playing an ever-increasing rôle in our world of mechanics and research, no other realm of twentieth-century science, it is safe to say, has produced more laboratory and industrial wonders than the research in the field of electronics. As a result, the tiny electron, relatively unknown not too many years ago, is becoming a mighty midget capable of doing a giant's work in the modern world.



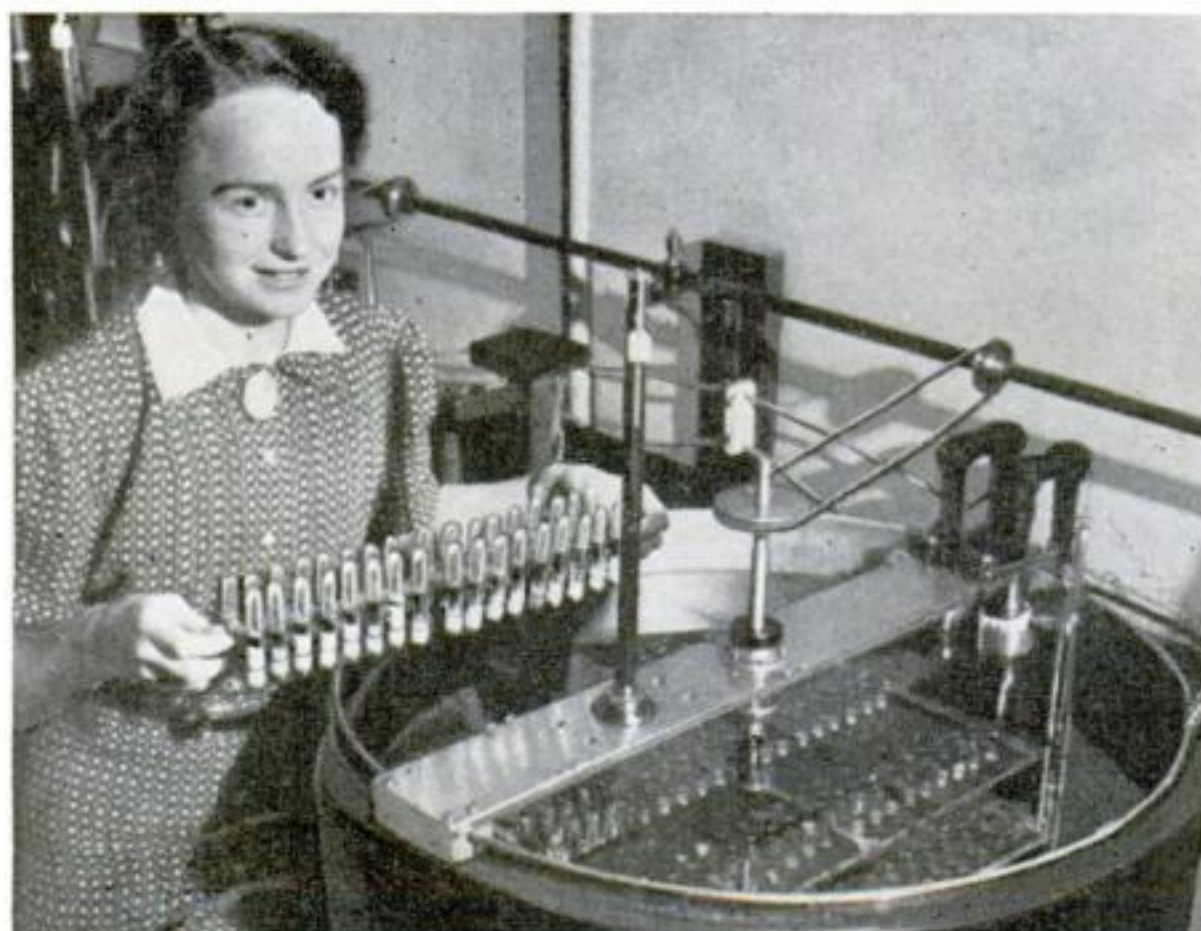
Electrons also contribute the stop-action lighting that gives us high-speed photographs like this one of a fencer in action



Mobile Weather-Forecasting Laboratory

INSTALLED in a small truck, a mobile, radio-equipped meteorological laboratory is now being used by Dr. Irving Krick, California meteorologist, to determine at various locations the temperatures, wind directions, and other weather data required for

his commercial weather-forecasting service subscribed to by movie studios, utility companies, and many other corporations. Above, Dr. Krick and his assistants are shown about to release a weather balloon equipped with an automatic radio transmitter.



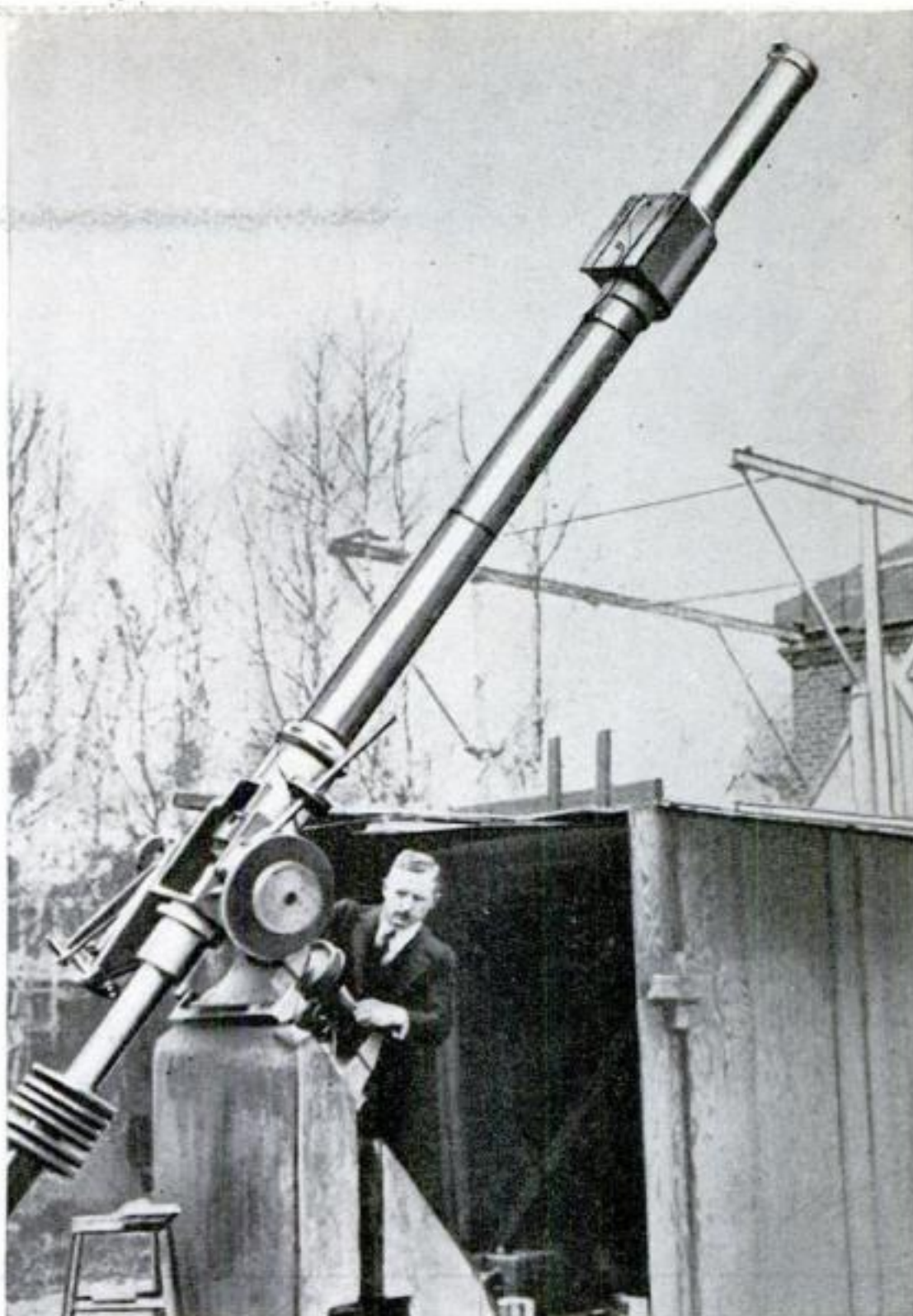
An oil bath keeps these electric cells always at the same temperature

What Is a Volt? Pampered Cells Supply Standard

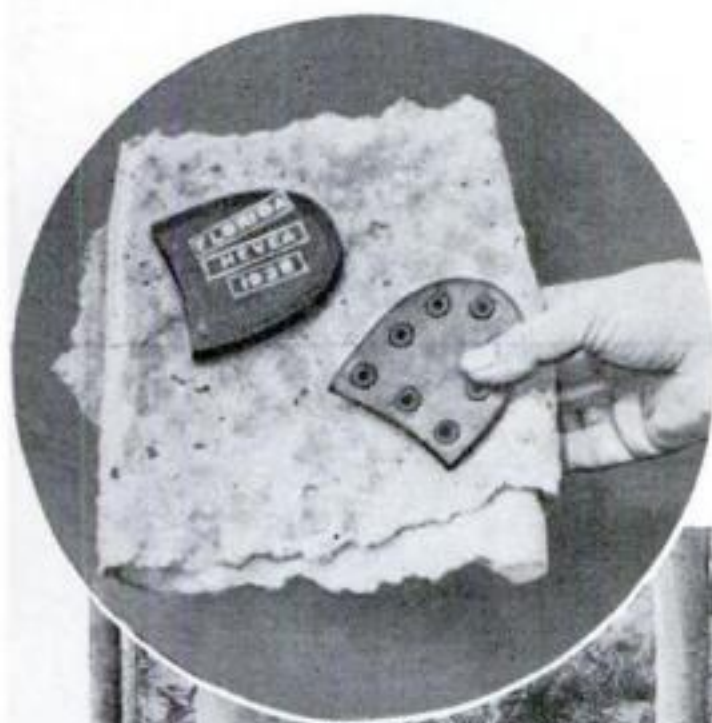
BECAUSE battery voltage varies with changes in temperature, the cells that serve as the standards of electromotive force, at the U. S. Bureau of Standards in Washington, D. C., are kept in baths of oil that are maintained at exactly the same temperature day in and day out. The electromotive-force standards of power companies and research laboratories are calibrated against the primary standard in Washington.

Solar Eclipses Made to Order with Sun Gun

LOOKING like a giant anti-aircraft gun, the strange astronomical instrument pictured at the right will be installed this summer at the world's highest astronomical observatory, erected at Fremont Pass, Climax, Colo., 11,138 feet above sea level. Called a coronagraph, the instrument creates artificial eclipses of the sun by means of special masking screens, to allow observers to study the sun's corona, generally seen only during a total eclipse. Solar corona observations are expected to reveal important information on magnetic "storms" that often cripple radio, telegraph, and telephone communications.



Not an antiaircraft gun, but a novel astronomical instrument



Technicians tapping hevea rubber trees at a Government experimental garden. In circle are heels and crepe rubber made from home-grown latex

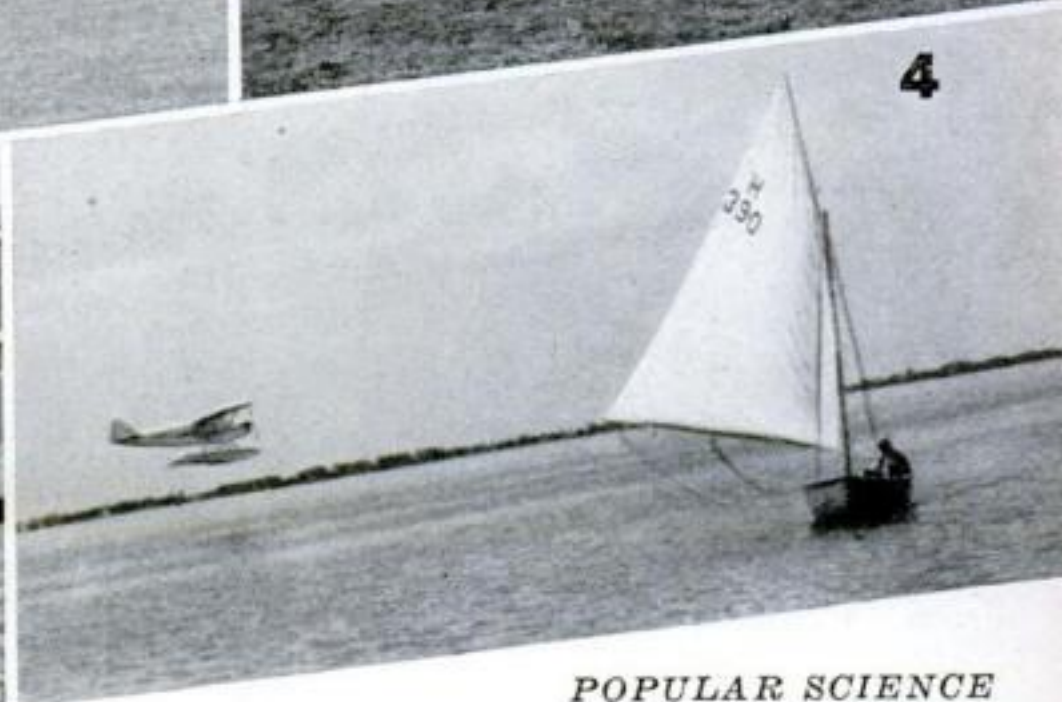
Rubber Heels Are Raised in Florida

RUBBER heels made of rubber grown in the United States! That is the accomplishment credited to Federal chemists and horticulturists who have successfully grown rubber trees at a Government-sponsored grove in Miami, Fla. Experts state that the home-grown rubber compares favorably with the imported East Indian product.

Flying Flivvers



A light-plane motor needs little more attention than the engine of your car



POPULAR SCIENCE

For Everybody



America Takes to the Air

As Economical Light Planes

Make Aviation a Popular Sport



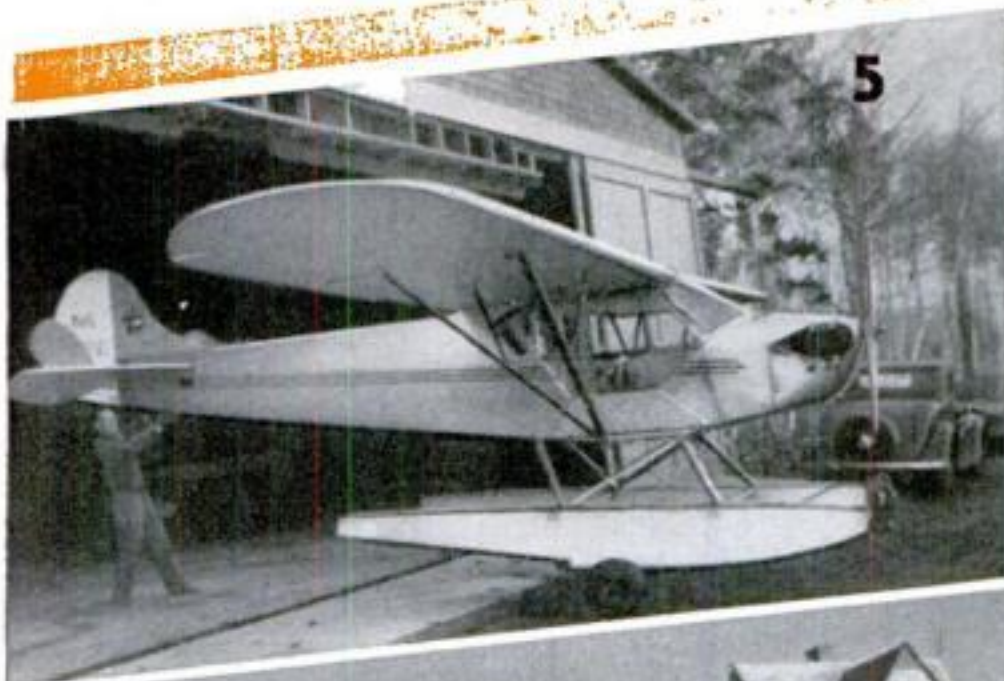
By
**EDWIN
TEALE**

EVERYMAN'S airplane is here. The flying flivver we have heard about for decades is now an actuality. Without fanfare, during the last few years, light planes which are cheap, economical, safe, and easy to operate have revolutionized private flying.

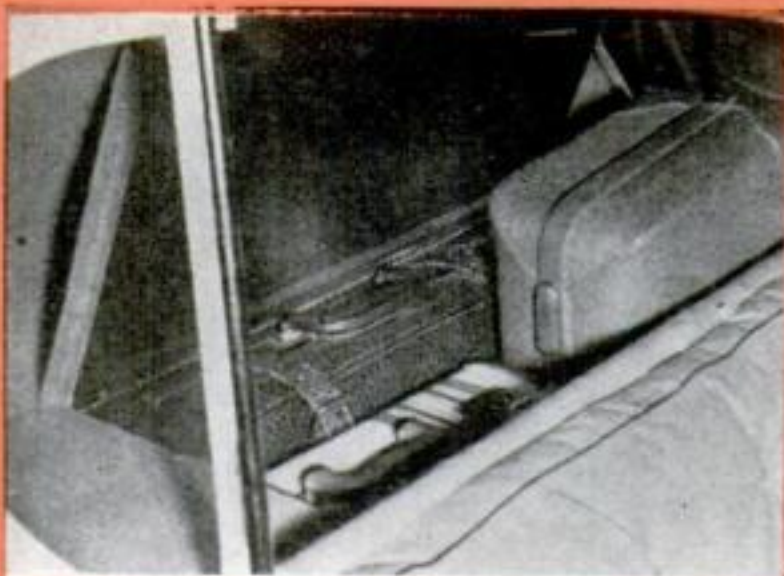
Today, you can purchase one of these aerial roadsters on easy terms with a down payment as low as \$333. You can use any level stretch the size of a football field for an airport. You get free flying instruction with the plane. Your engine requires only slightly more attention than the motor of an automobile and it carries you between twenty and thirty miles on a gallon of gasoline. Your machine, traveling 100 miles

an hour, accommodates two and in some cases three persons. If your motor cuts out in the air, so gentle is your gliding angle that, from 5,200 feet, you can land in any field you choose within an area of 340 square miles!

The other day, at Lock Haven, Pa., I had an opportunity to discover at first hand the ease with which a modern sky flivver handles aloft. I had driven over, the night before, to the immense red-brick Piper Cub plant—the nest where six out of every ten American light planes are hatched. On the flying field, close to the Susquehanna River, I climbed up beside Bill Strohmeier in the



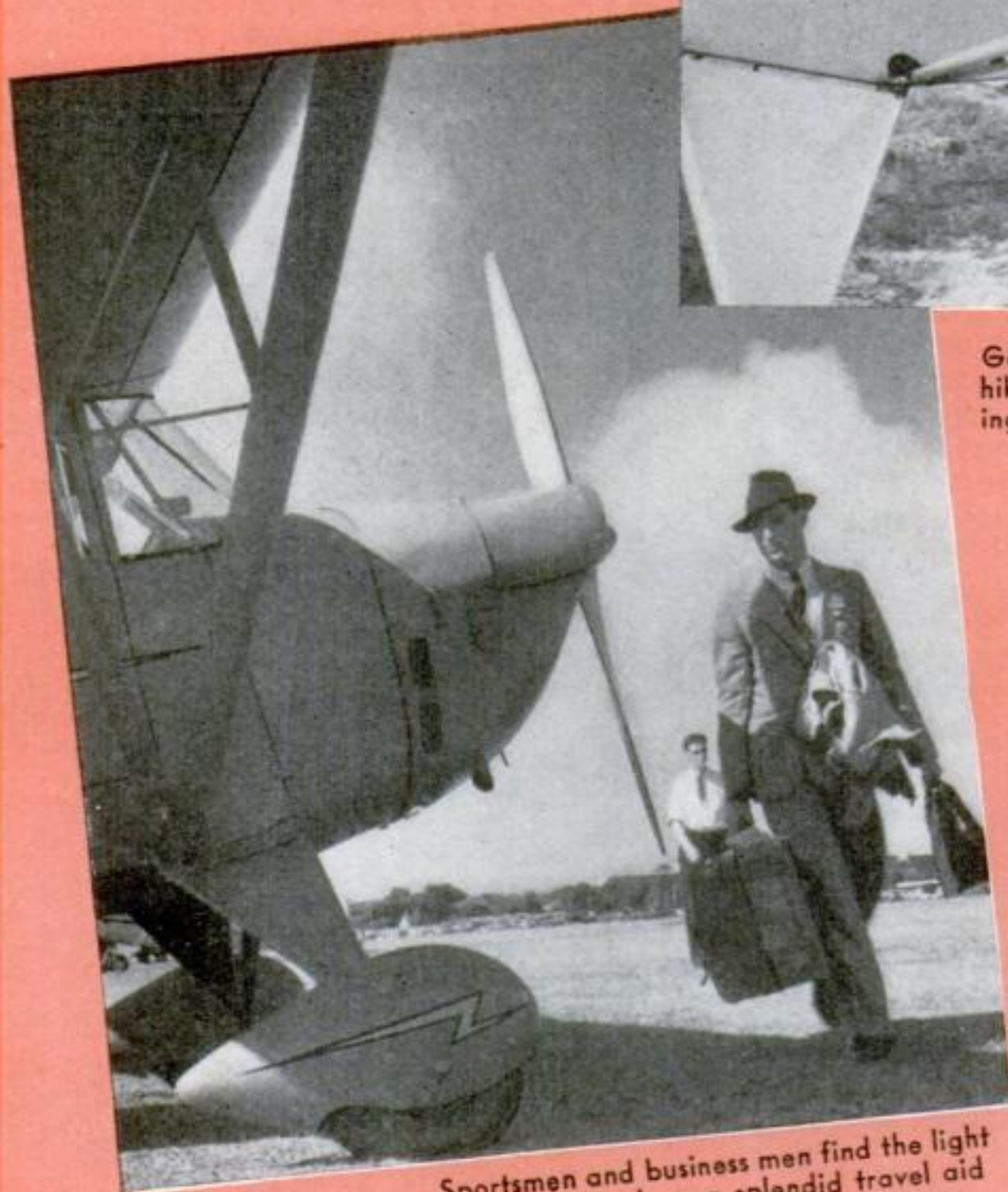
Flivver planes go everywhere: 1. Landing on a lawn with pontoons demonstrates safety. 2. Flying provides a milkman's holiday. 3. Aviation comes to the farm. 4. Wings challenge sails on the water. 5. A lake-shore hangar. 6. Cloth "nightgown" protects this plane at a summer cottage. 7. The lawn of a country estate serves as a landing field. 8. Clearing snow off the wings for a hop to the sunny South in the Light-Plane Cavalcade



Bags stowed in a luggage compartment for a safe and economical vacation trip by plane



Going my way? Aerial hitchhikers have appeared, thumbing rides among the clouds



Sportsmen and business men find the light plane a splendid travel aid

stick, removed his feet from the rudder pedals, and calmly said:

"She's all yours."

I had never touched the controls of an airplane in my life. Tense from head to foot, ready for anything to happen, I gingerly moved the stick and the pedals. The plane responded instantly. Minute after minute went by. We went into neither a stall, a nose dive, nor a tail spin. I began to relax. So inherently stable,

streamline cabin of a red-and-white Cub coupe. We sat on automobile-type cushions facing an automobile-type instrument board while the muffled, sixty-five-horsepower engine warmed up. Then Strohmeier released the brakes and pulled back the throttle. In 300 feet the ship was in the air.

We were 2,000 feet above the valley when Strohmeier took his hand off the control

so easy to operate, so low in stalling speed is the modern light plane that for fifteen minutes I guided the ship about, rising and descending, and even making great circles over the valley below. When Strohmeier took over for a landing, we came in at hardly more than thirty-five miles an hour and stopped with a run of 200 feet.

Such modern planes are far beyond the

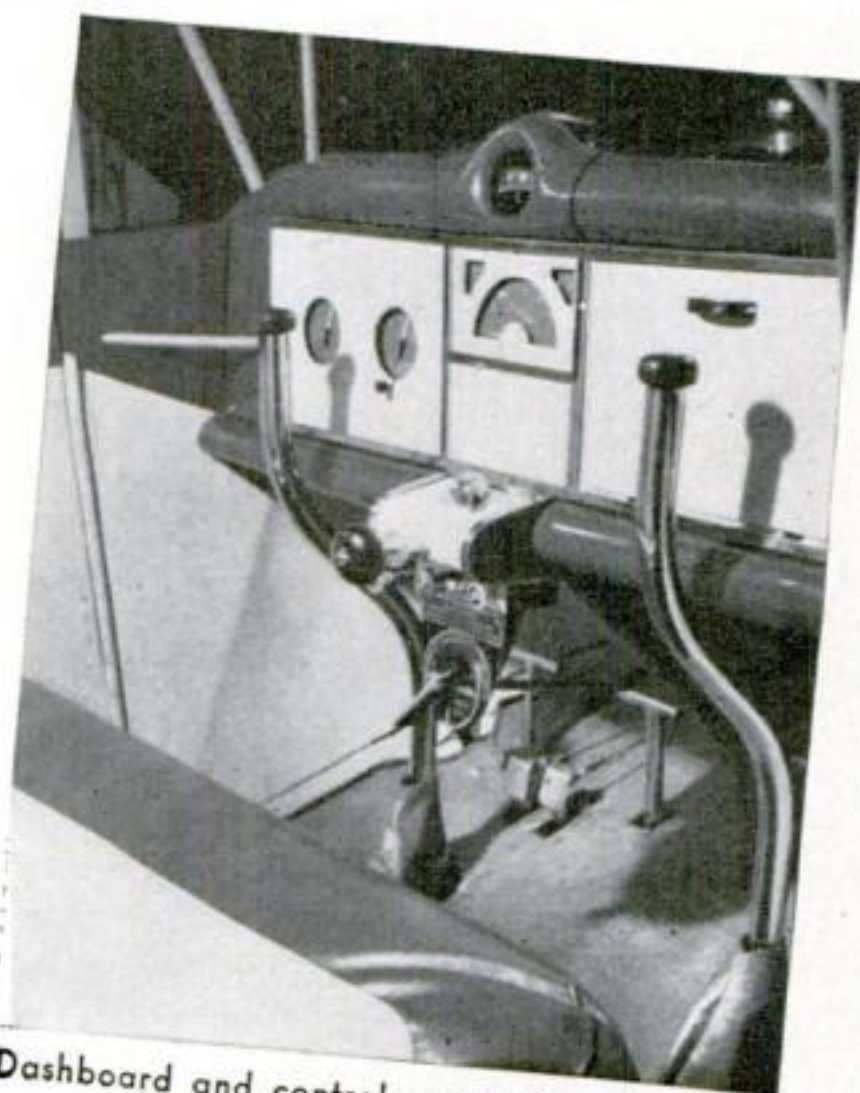


Many cities now even boast attractive light-plane salesrooms like this one located in New York City

experimental stage. They are no longer an oddity, no longer a rich man's toy. Their everyday reliability is bringing sweeping changes in sky travel. Already, the safety of the light plane has cut insurance rates in half. Already, its economy permits a student to learn to fly for a fraction of the former cost. Already, its low initial cost has enabled thousands of amateurs to enjoy the thrills of private flying.

Last year, more than 500 owner-pilots took part in the annual midwinter "Light-Plane Cavalcade" in which ships from all over the country, and as far away as Alaska, converge on Florida. Another high point in the yearly activity of flivver-plane flyers is the aerial field day when picked teams from more than thirty universities and colleges compete for annual awards totaling \$15,000. These two events spotlight the widespread advance of private flying. They also dramatize the progress of the light plane in passing the twin hurdles—danger and expense—which have always stood in the path of the long-awaited airplane for Everyman.

The story of these machines, which are so rapidly changing the picture of private flying, is a record of less than a decade. In the early thirties, planes designed with the one aim of keeping them light, simple, safe,



Dashboard and controls are extremely simple

and inexpensive, made their appearance. The resulting boom in private flying has risen year by year and is yet to reach its peak.

By 1935, flivver planes represented a quarter of the total aircraft production for the



Landing right on the ice, this angler loses no time in getting where the fishing is good

Below: tuning up the motor. Light planes make from twenty to thirty miles on a gallon of gas



country. Three years later, in 1938, the Piper Cub factory passed the 1,000-planes-a-year production mark—the first concern in all aerial history to reach this goal. W. T. Piper, president of the company and the “Henry Ford of the light-plane industry,” learned to fly when he was fifty and at fifty-nine piloted one of his two-place machines on a 7,500-mile solo journey that carried him through sixteen states.

In 1939, the Cub plant turned out 1,800 light planes and total production for all the popular makes—the Aeronca, the Cub, the Luscombe, and the Taylorcraft—was close to 3,000. This year, more than 200 planes a month are expected to roll from the production line at the Lock Haven factory alone. In every state in the Union and in nearly forty foreign countries, American light planes are active in the sky.

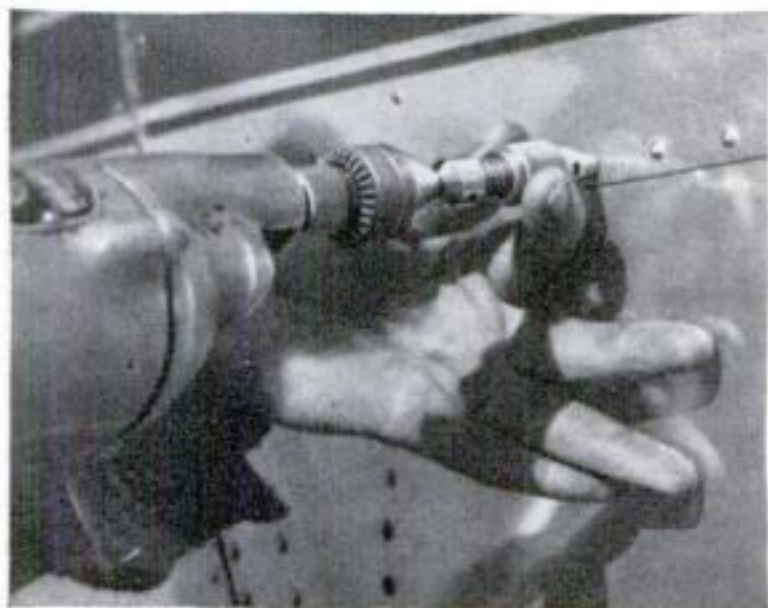
Owners range from a 300-pound West Virginia druggist to a 3½-foot-tall Massachusetts midget, who wears a specially designed, small-size parachute when he flies. There are six light-plane pilots in a single family in Fort Morgan, Colo. There are three generations of flivver-plane enthusiasts taking turns at the stick in another family in Virginia. So many elderly people are taking up the sport, in fact, that a “Grandfathers’ Flying Club” has active members all over the country.

At the opposite extreme from the flying graybeards is Margaret Ann Hostetter. When her parents, not long ago, flew from Hanover, Pa., over the Alleghenies, across the Mississippi Valley, and above the Rockies to Spokane, Wash., and return, six-months-old Margaret Ann rode in a luggage-compartment crib wearing little ear muffs to deaden the sound of the motor. In Anderson, S. C., Howard Behr, another flying father, uses his light plane for putting his baby to sleep. Already, the baby has twenty-seven hours of flying time entered in a little log book of its own.

Although a Cub light plane holds the world’s refueling endurance record with more than thirty days continuous flight; although an Aeronca has flown from coast to coast non-stop; although the pilots who won highest honors in stunting at the last National Air Races looped and rolled in light planes—the most spectacular feature of these machines (*Continued on page 212*)

Collar Adapts Drill for Removing Rivets

MAYLAND BURNS, a New York City airplane mechanic, noticed that drilling a faulty rivet out of an airplane's "skin" increased the diameter of the rivet hole, making it necessary to substitute a larger rivet. So he devised a drill collar made to fit the rivet head so that a drill drives through the head and down into the rivet shaft. A rivet of the same size can then be inserted in the hole. The collar is seen in use in the photograph below.

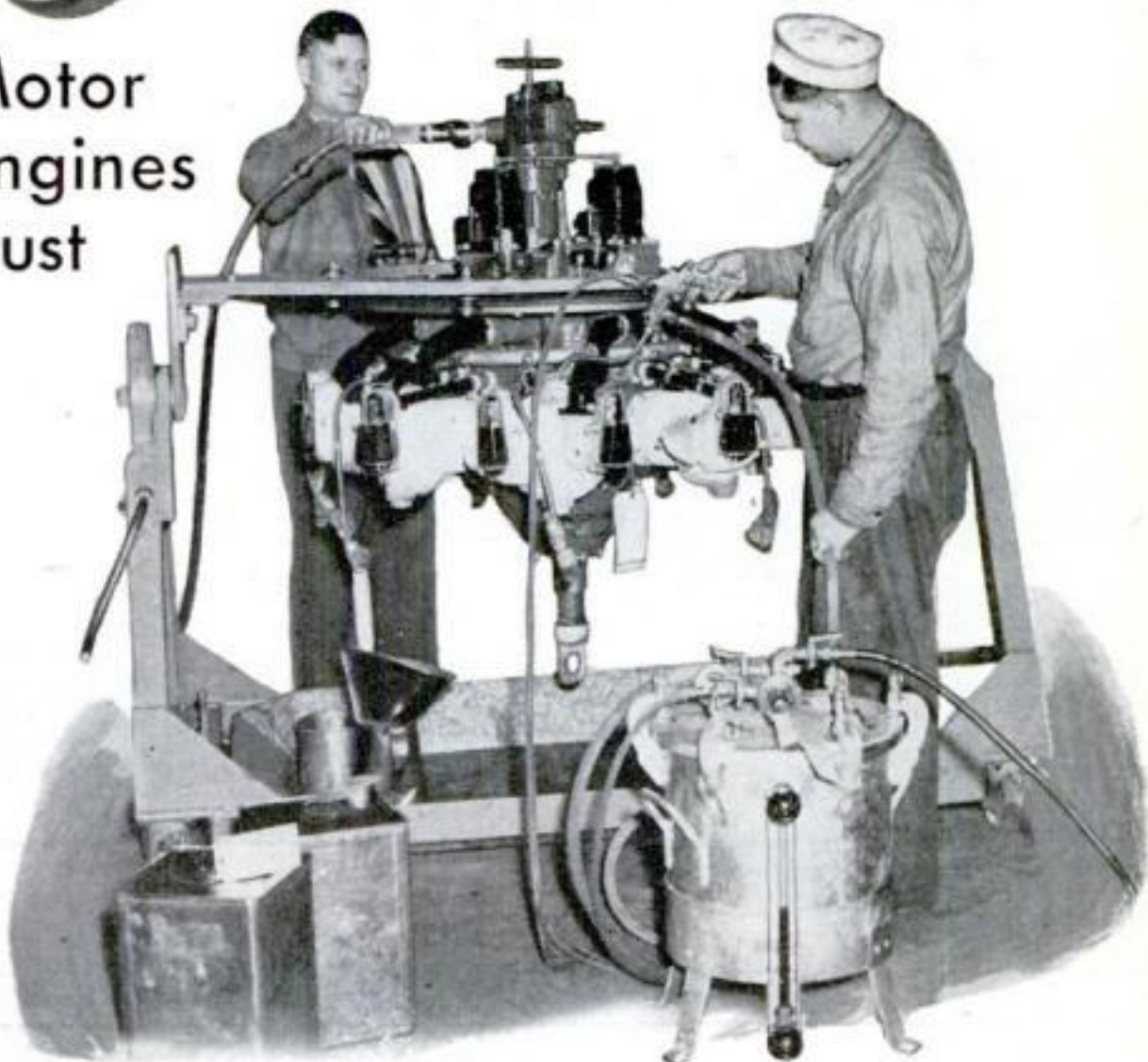


Removing a faulty rivet without enlarging hole. A special collar for the drill makes it possible



Air-Powered Motor Helps Grease Engines To Prevent Rust

AIRPLANE engines that are removed from planes for long-time storage must have each part carefully protected against the ravages of rust and deterioration. For this reason, mechanics coat all engine surfaces with a protective bath of oil and grease. To make this process easier and more effective, a U. S. Coast Guard mechanic recently thought up the idea of using a compressed-air motor to turn the engine over slowly as the protective oil was sprayed onto valves, bearings, and other working parts.

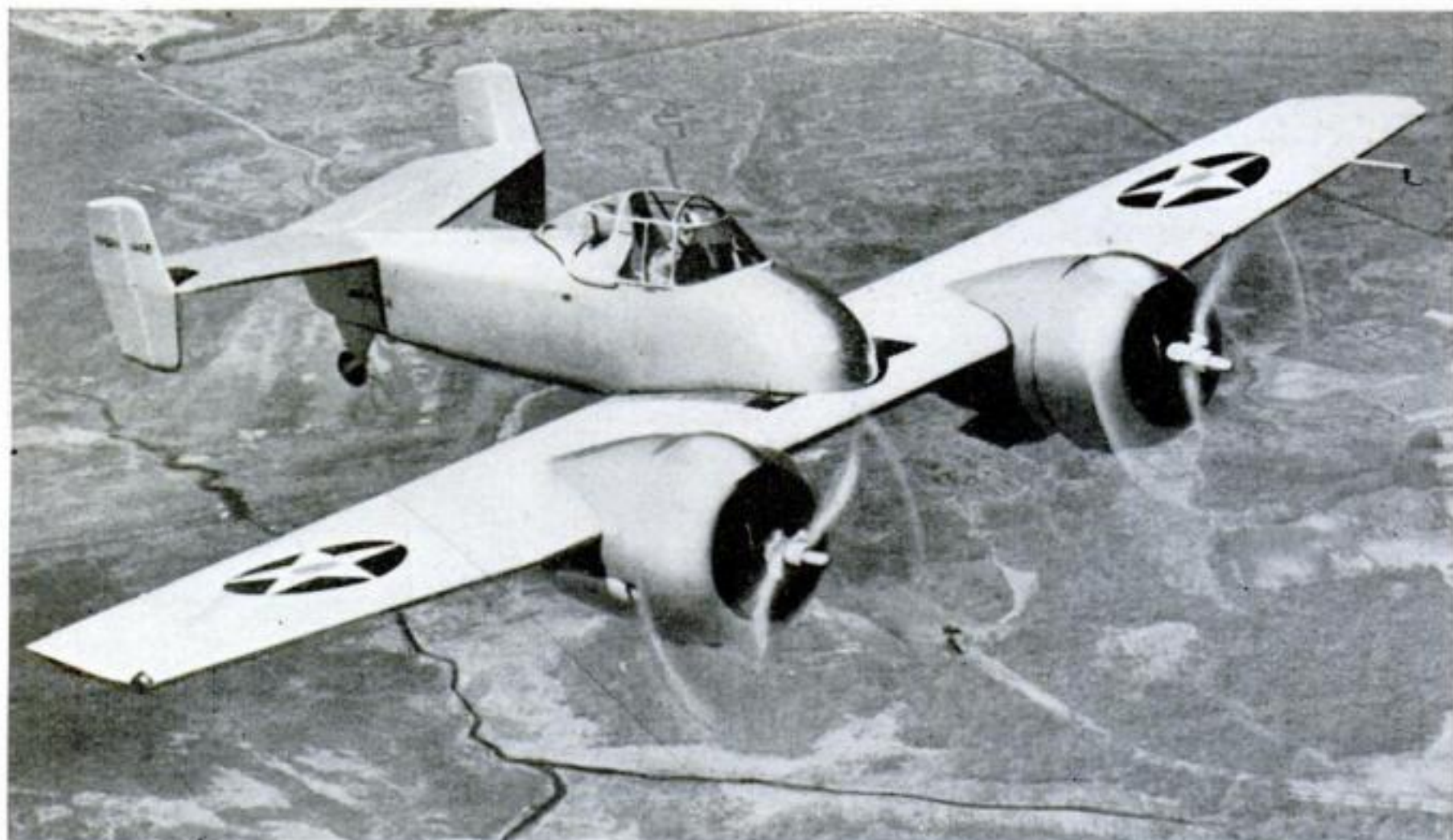


Coast Guard mechanics greasing an engine for protection in storage

Plane Trip Canned on Disk

SOUNDS heard on a typical transcontinental airplane flight—the roar of motors, the sound of radio-beam signals, the voices of pilots, dispatcher, and stewardess—are recorded on an unusual disk now available. The record was made during a flight of the American Airlines' "Mercury."





Pursuit Ship Hits 450 Miles an Hour

ZOOMING almost straight upward after a seven-second take-off run, a new pursuit plane designed for the U. S. Navy roared into the air recently on its first public exhibition flight. Although most details of its performance were not released, the

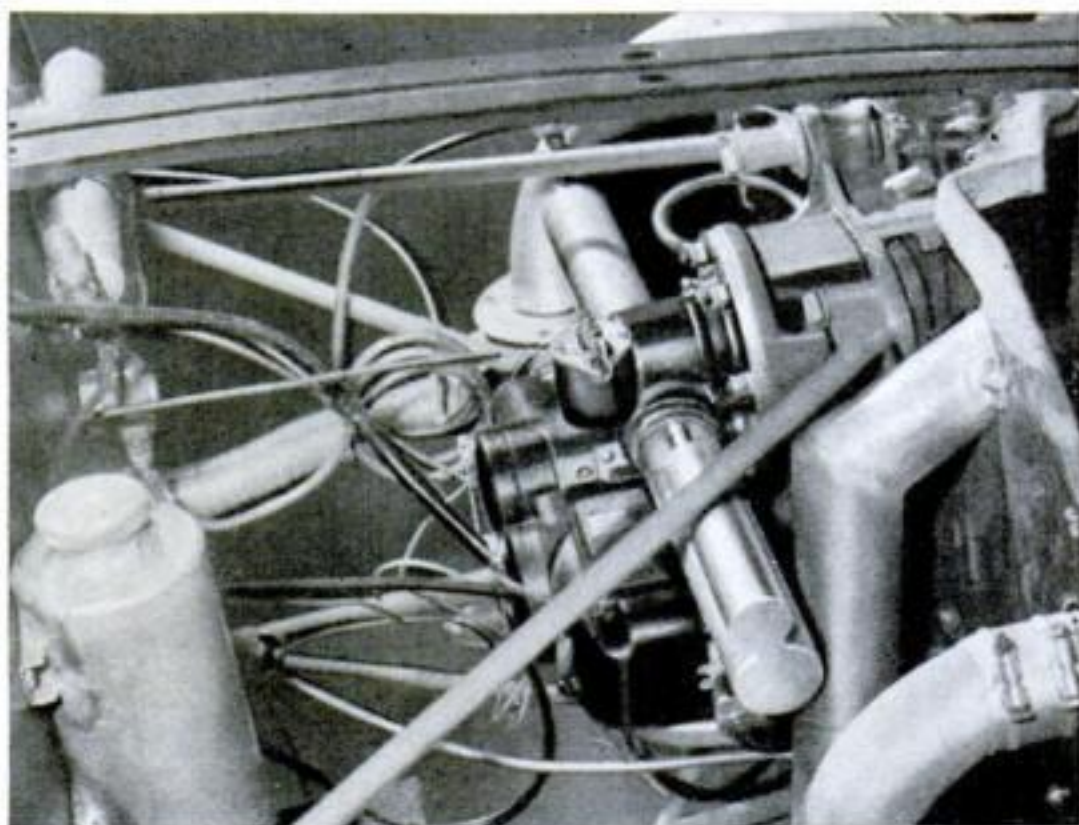
speedy fighter is propelled by twin 1,200-horsepower motors said to drive it through the air at a top speed of 450 miles an hour. Long range is another feature of the craft, which is reported to be able to mount two aerial cannons and four machine guns.

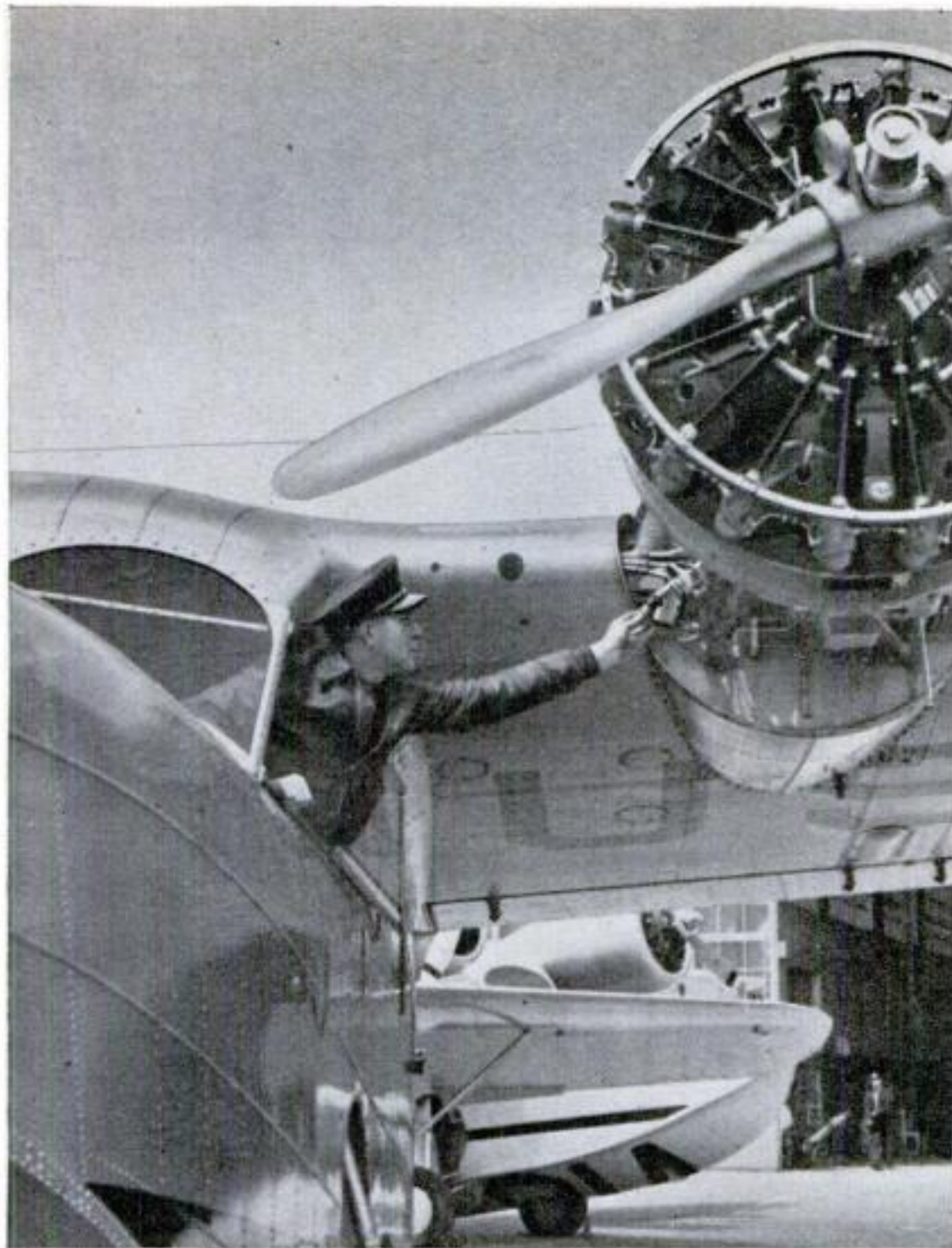


Oil pressure powers this compact starter, shown installed on a light-plane engine in photo at right

Light Starter for Light Planes

TIPPING the scales at only fifteen pounds, a hydraulic engine starter is now available for installation on light planes. Oil put under pressure by means of a hand pump within the cabin of the plane is released to whirl an impeller wheel, which in turn starts the plane motor.





How a pilot can insert a cartridge and fire it from the cockpit

Plane Motors Get Novel Starters

PLANES of the U. S. Coast Guard at Floyd Bennett Field, New York City, are now equipped with self-starters of the explosive-cartridge type that fires a charge of gas into the motor to set it in motion. The cartridge chamber is located directly on the engine mounting for maximum efficiency, but is so placed that a pilot can reach from the cabin window to load and fire it.

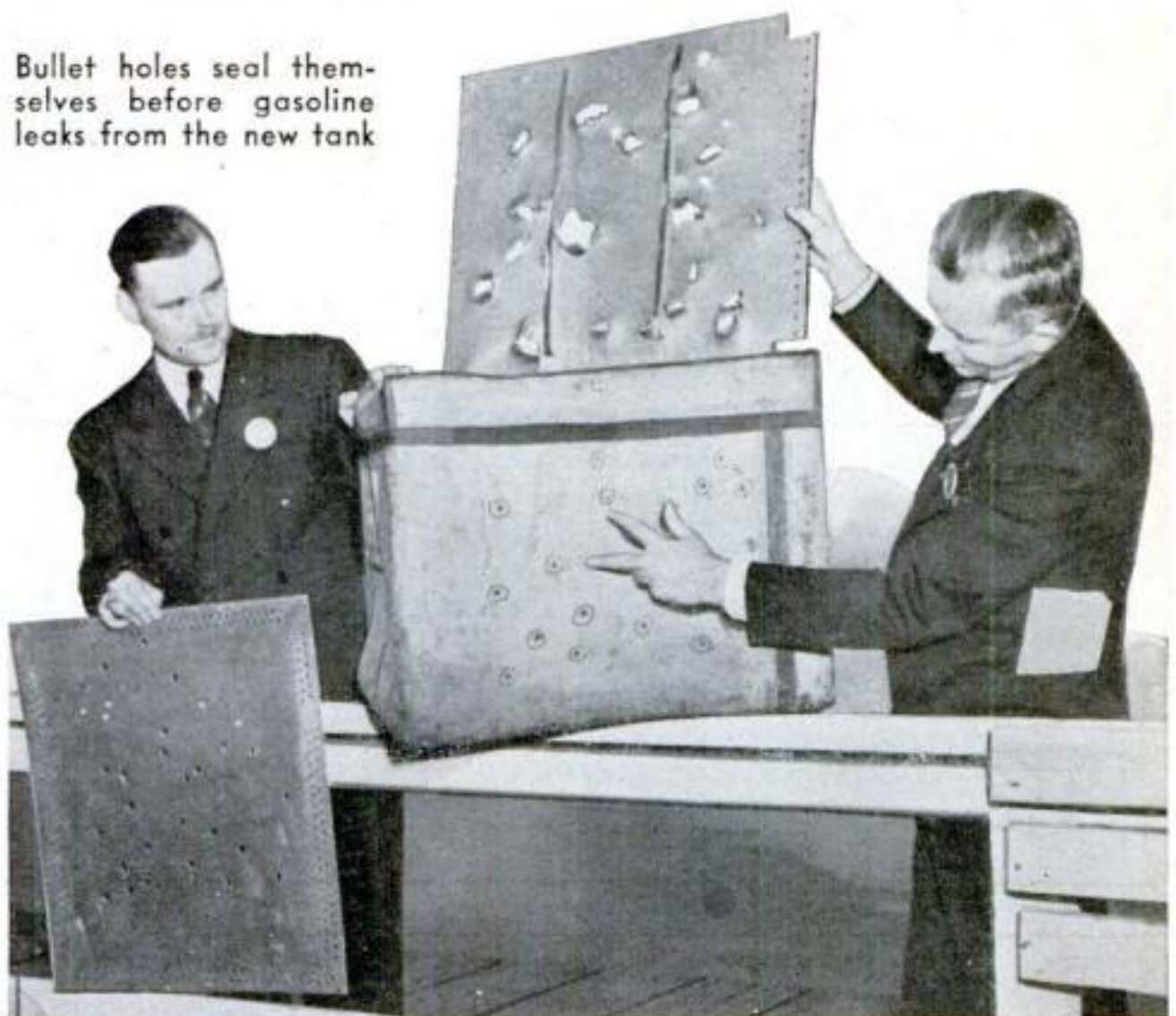
Batteries Power Electric Airplane

LIGHTWEIGHT storage batteries, instead of gasoline tanks, furnish the "fuel" for a 300-mile-an-hour electric airplane reported to be under construction by Canadian engineers. In addition to its high top speed, it is reported that the plane, the first of its kind in the world, will have a cruising range of three hours.

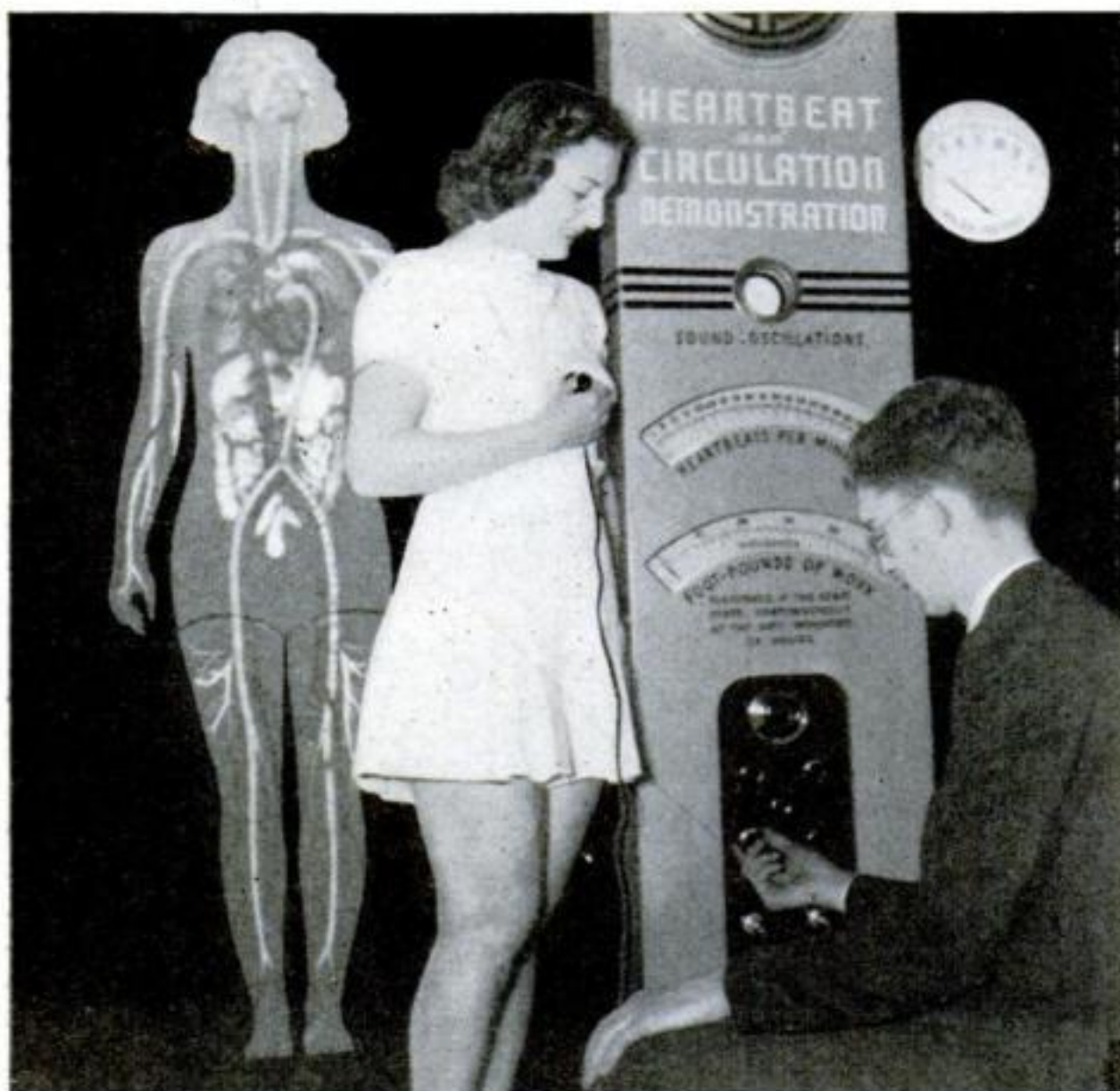
Bullets Can't Harm New Rubber Gas Tank

EVEN after thirty-two armor-piercing .30 caliber bullets had been fired through the walls of a new self-sealing gasoline tank for airplanes, shown at the right after the recent demonstration, the tank remained free of leaks. Designed for military planes, in which one of the points of greatest vulnerability in combat is the conventional fuel tank, the new tank is made of a type of rubber that seals itself after it is punctured. An aluminum-alloy shielding gives rigidity to the rubber cell. It is expected that the new tank will soon be tested in actual warfare.

Bullet holes seal themselves before gasoline leaks from the new tank



"X-Ray" Robot Shows How Heart Works

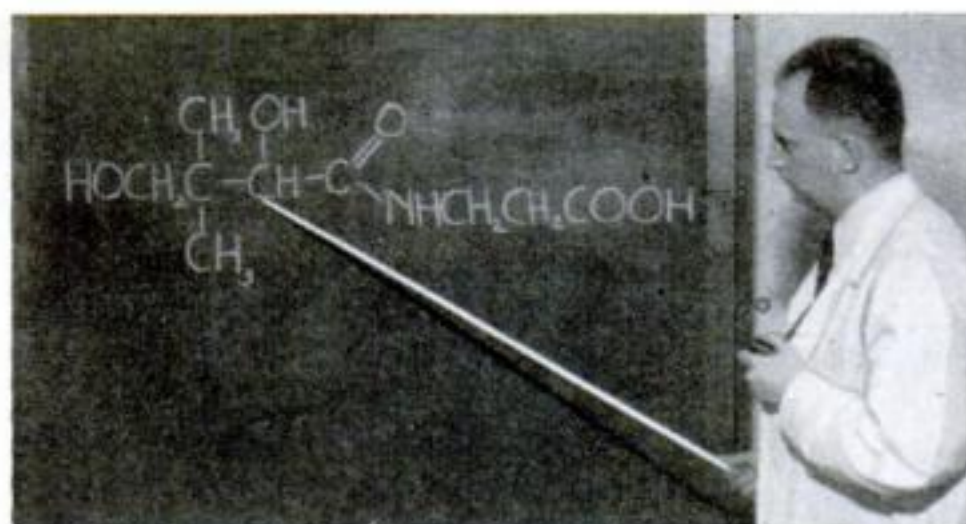


Note the microphone in the girl's hand. It picks up the beat of her heart

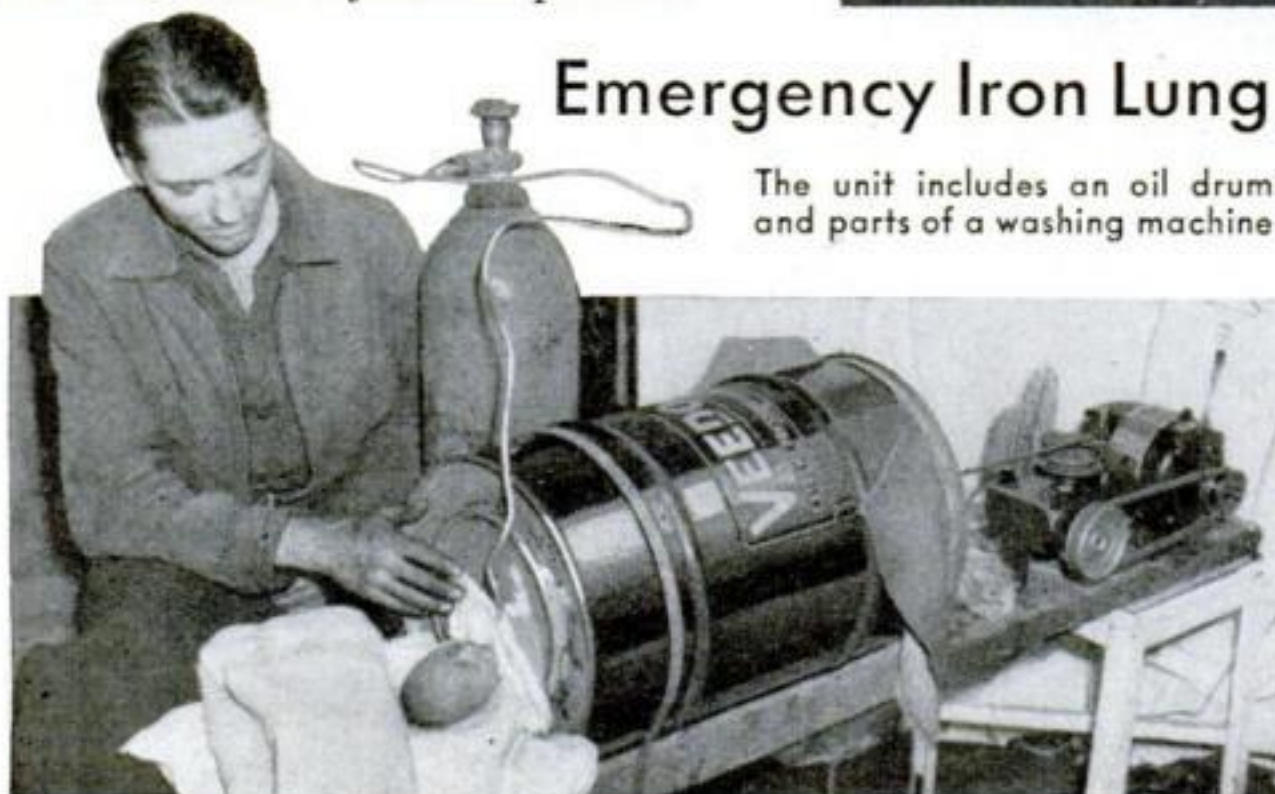
WITH a pretty girl as a "stand-in," a novel animated figure shows how the human heart responds to emotions and physical work. Heartbeats of the human subject, picked up by a supersensitive microphone, govern the pulse of a mechanical heart in the model. Red lights in arteries and blue lights in veins flash to show blood circulation, and the sound of the heartbeat is magnified 1,000,000 times by a loudspeaker. When the girl pedaled a bicycle-type exerciser, in one trial, the robot showed the rise in her pulse rate. The same result was obtained, an experimenter reported, by kissing the subject. The effect on the experimenter's heart was not disclosed.

Acid-of-Life Vitamin Is Made Artificially

PANTOTHENIC acid, eighth and latest vitamin, out of ten recognized ones, to be produced synthetically, may prove a valuable new medical aid. Found in nearly all living tissue, and called the "acid of life," it has the formula shown at right. Its calcium salt is a white crystalline powder.

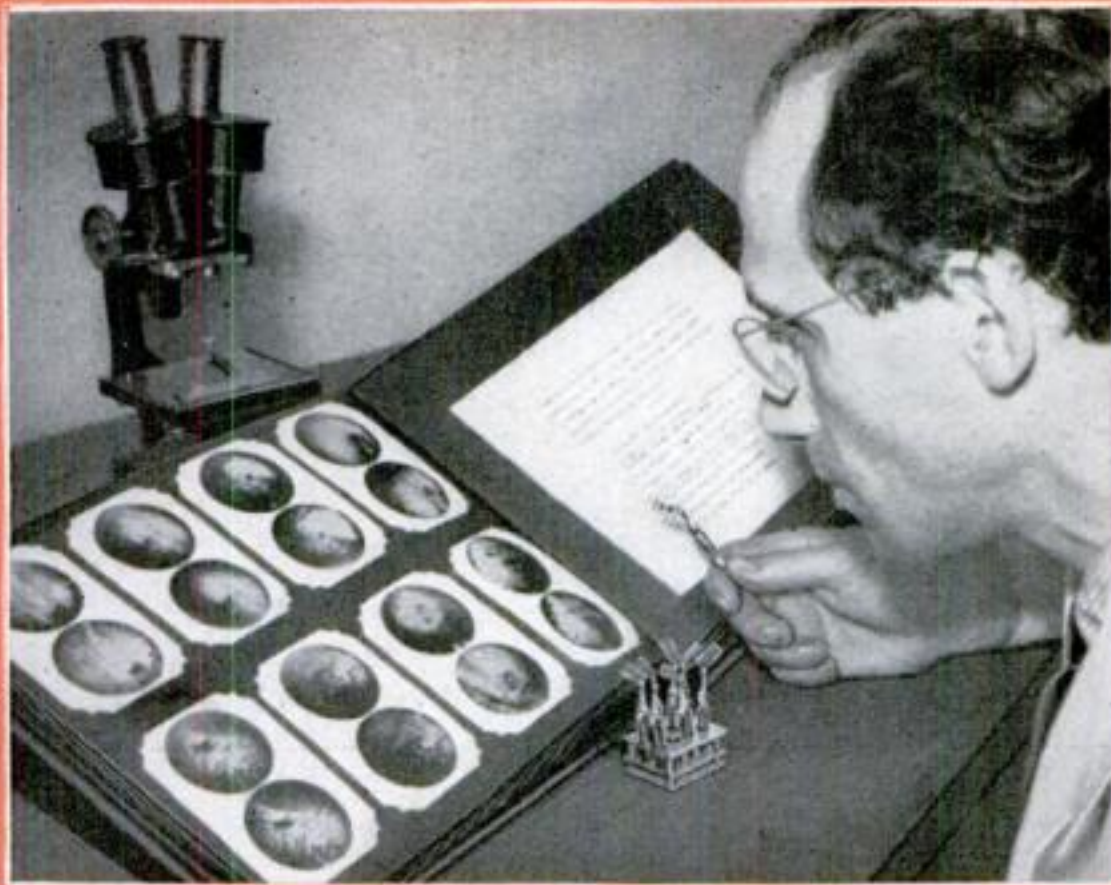


Emergency Iron Lung Made at Home

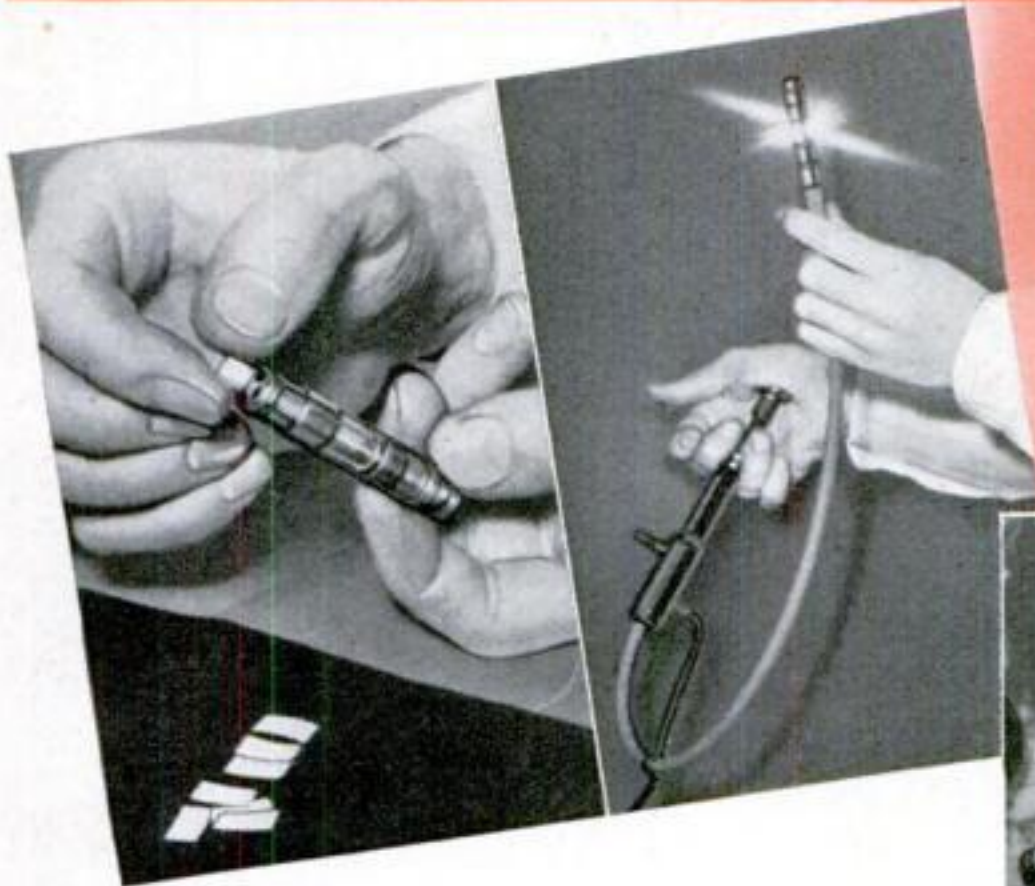
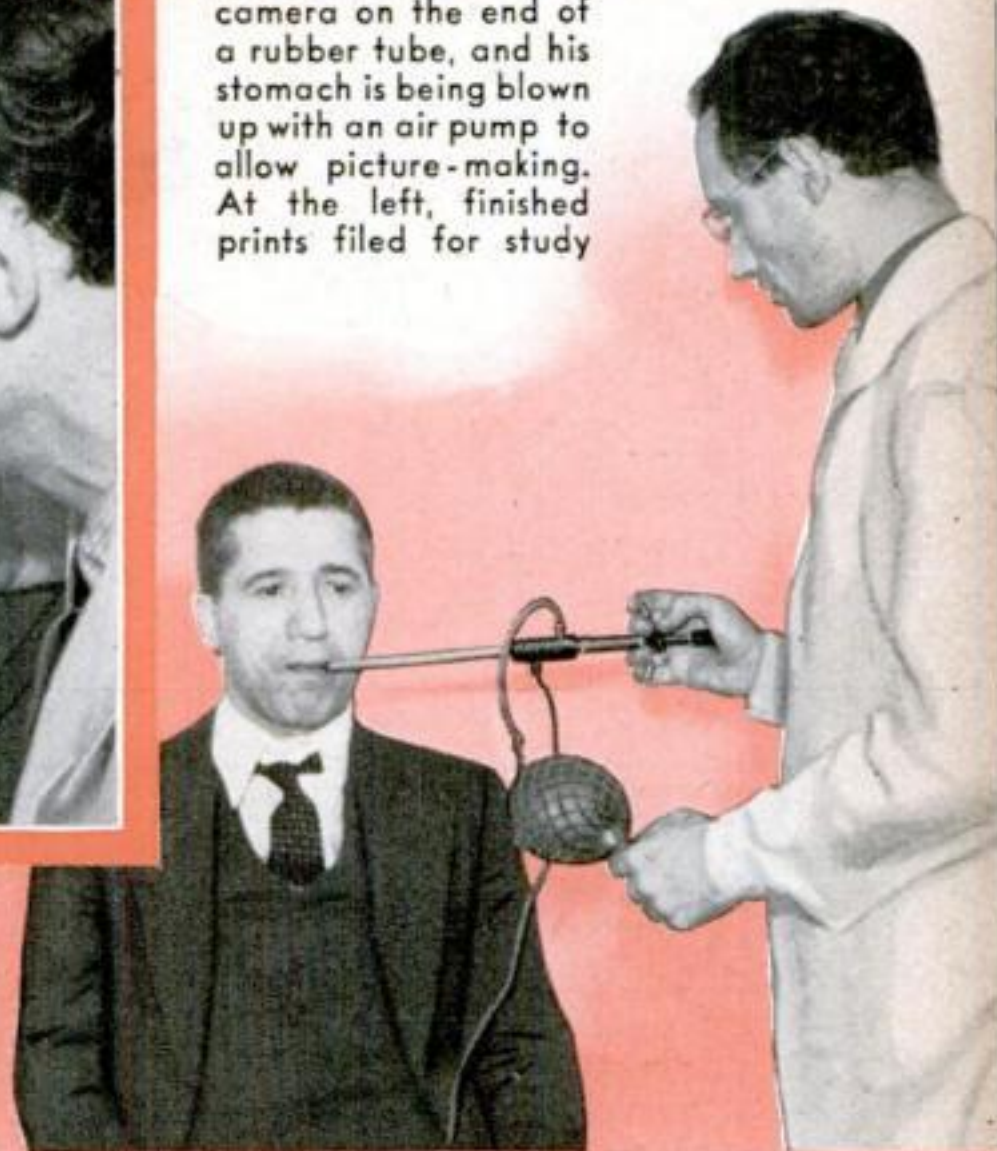


The unit includes an oil drum and parts of a washing machine

IN A vain attempt to save the life of his premature baby, a Johnson City, Ill., father improvised a homemade iron lung as efficient as a professional model. While his doctor applied artificial respiration, he used an oil drum and parts of a washing machine to fashion the apparatus, which kept the infant alive for two days.



The patient below has just swallowed a tiny camera on the end of a rubber tube, and his stomach is being blown up with an air pump to allow picture-making. At the left, finished prints filed for study

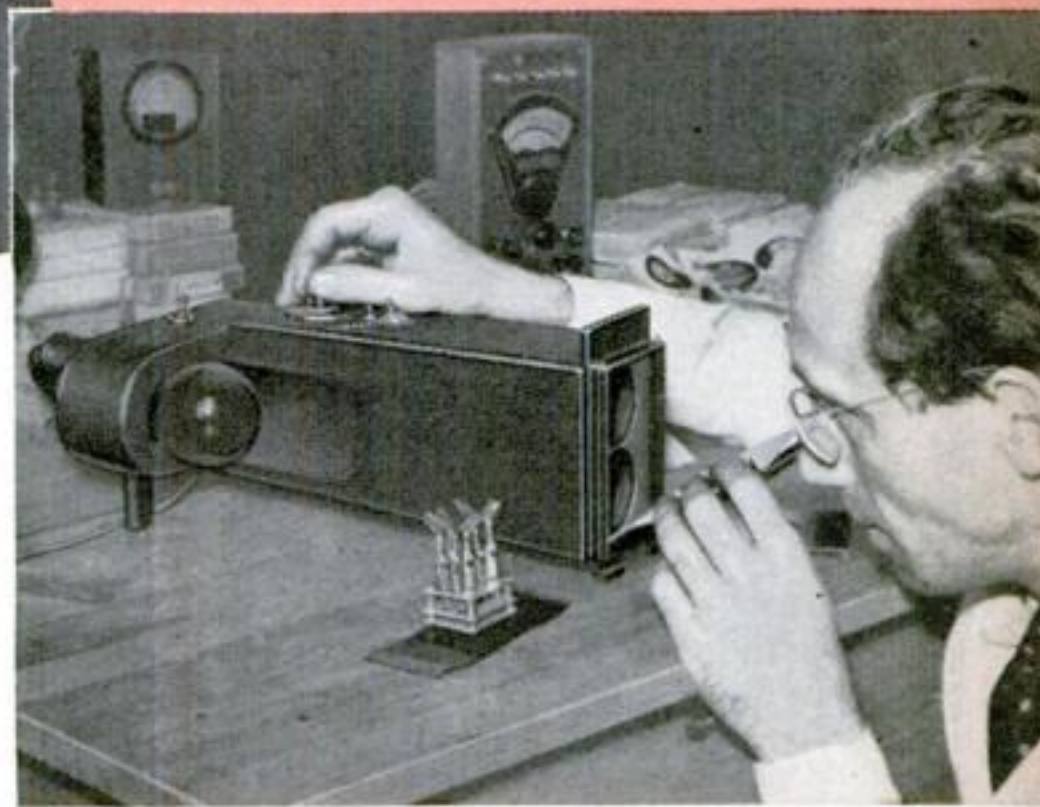


At far left, the camera is being loaded. Left, built-in flash bulb in operation. Below, making enlargements from the negatives seen in small rack

Three-Dimensional Photos Are Made Inside the Stomach

STEREOSCOPIC photos, made with a camera little larger than a cigarette, now promise quick and accurate diagnosis of stomach ills. After the patient swallows the camera at the end of a tube, a rubber air pump inflates his stomach for unobstructed visibility. Pushing a button then sets off a tiny flash lamp built into the camera. Through pinholes in its barrel, four films set at right angles to each other, in each end, receive images of the whole cir-

cumference of the stomach. This yields sixteen pictures, or one pair of views on each quarter-inch by half-inch negative. When enlargements to two-inch diameter are viewed in a stereoscope, prominences and hollows stand out in vivid relief. The entire picture-taking operation takes less than a minute, and requires no special preparation.



Soil Yields New Germ Killer

FRIENDLY germs that prey upon infectious ones have been found living in the earth beneath our feet. Like specialized arms of a military machine, some new-found soil germs attack specific objectives. One kind of underground bacillus secretes a chemical that dissolves the "armor plate" or protective coating of pneumonia germs, leaving them easy victims. Typhoid, dysentery, and cholera germs all have their own particular microscopic foes. Another strain of beneficial soil germs destroys a great variety of toxic ones, including those of diphtheria and tetanus.

Proof of these hitherto unknown facts has been obtained by Dr. R. J. Dubos, of the Rockefeller Institute, and by Drs. S. A. Waksman and H. B. Woodruff of the New Jersey Agricultural Experiment Station. First they cultivated myriads of deadly bacteria on plates coated with agar, a gelatinous material derived from seaweed. Then they inoculated the cultures with soil containing the friendly germs, which proceeded to thrive and multiply. The disease germs disappeared. They were killed by chemical warfare, another test showed. To prove it, chemicals were extracted from soil germs, and were found equally fatal to disease bacteria. Injected in mice, a trace of such a chemical protected them from pneumonia and other infections.

Many more experiments must be made before extracts from soil germs, or synthetic counterparts that may be developed, can be tried out on human patients. But an eventual possibility may be a specific, bottled cure for every common infectious ailment. A new avenue of research has been opened toward the conquest of disease.

Since the beginning of medicine, scientists have searched for remedies so selective as to attack the germ without harming the patient. Classical examples of their successes have been quinine for malaria and

ipecac for dysentery. But these diseases were due to microscopic parasites of the animal kingdom. Until four years ago it was believed impossible to attack plant organisms as primitive in structure as bacteria with chemicals.

Sulfanilamide, the miracle drug whose name is now a household word, and its newer chemical relatives, including sulfapyridine and sulfathiazole, have completely overthrown this mistaken belief. Today, hundreds of members of the sulfanilamide family of compounds are being prepared and are saving countless lives. Their effectiveness has been shown against meningitis, blood poisoning, streptococcus sore throats—and especially against pneumonia, most important from the standpoint of mortality. A prominent life-insurance statistician attributes last year's phenomenal "low" in pneumonia fatalities largely to the introduction of sulfapyridine, and predicts that within only a few

years pneumonia will have dropped from a high-ranking to a minor cause of death. Meanwhile, search continues for more active chemical agents against tuberculosis and other plagues, with good prospect of success.

Recent creation of the first synthetic vaccine marks a new stride ahead in the prevention of disease, a second phase of science's war on germs. Picturesque reports tell of triumphs already achieved by immunizing people against ills.

Particularly timely because typhus epidemics may follow wars, a new mass-production method of producing typhus vaccine has been perfected at the Harvard Medical School. Grown first on hen's eggs and then on agar, the germs multiply with record speed. For the first time, enough vaccine can be produced in a hurry to protect a whole country, and perhaps the entire world, from this dread scourge.



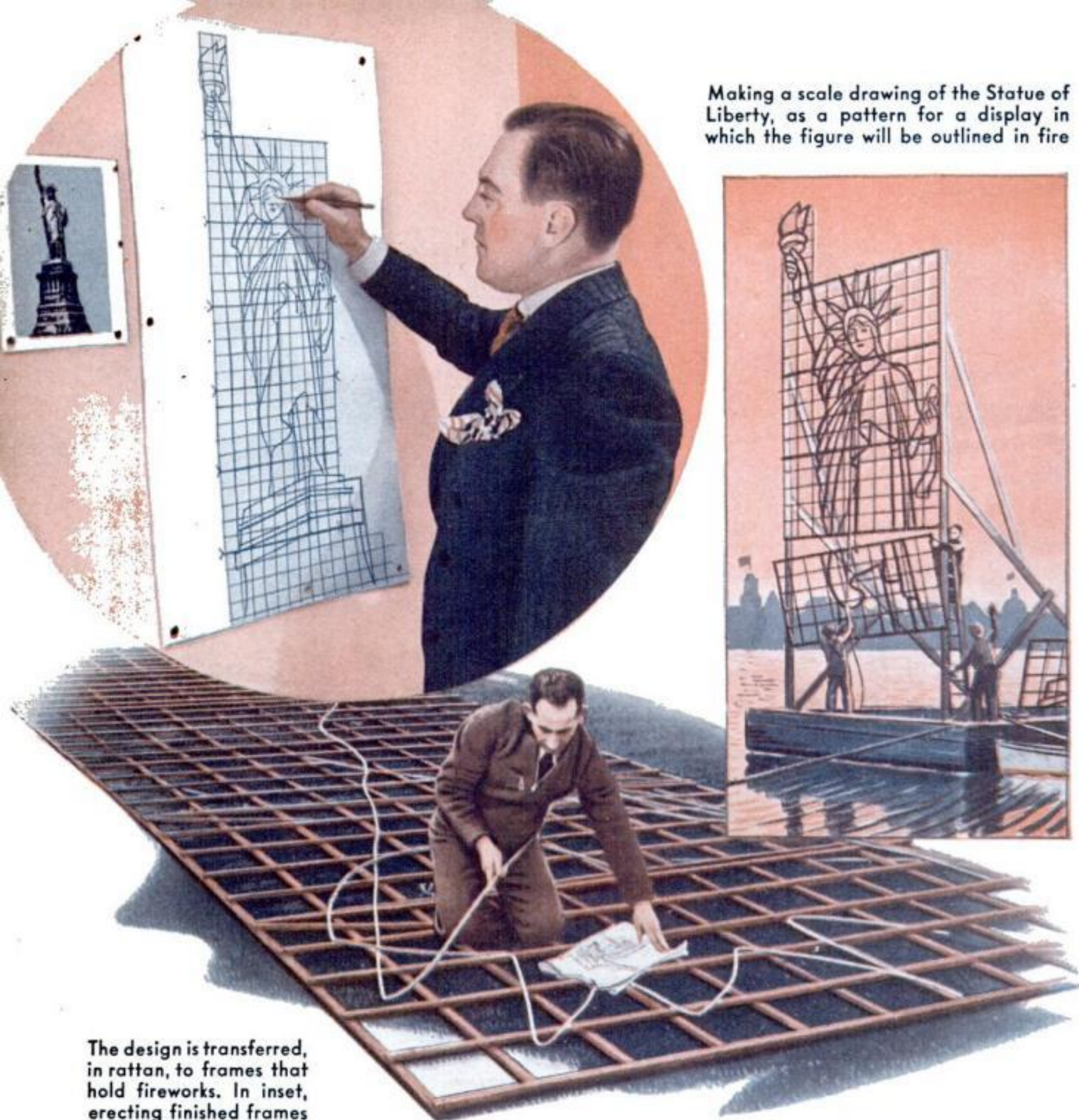
In medical research laboratories, friendly germs are enlisted for the war on disease



Wizards of Fire

By
KENNETH
SWEZEY

Making a scale drawing of the Statue of Liberty, as a pattern for a display in which the figure will be outlined in fire



The design is transferred, in rattan, to frames that hold fireworks. In inset, erecting finished frames

**HOW FIREWORKS ENGINEERS
DIRECT FLAMES AS ACTORS
IN THRILLING SPECTACLES
THAT RIVAL PRODUCTIONS
OF THE STAGE AND SCREEN**

DRAMATISTS in fireworks! That is the newest and most exciting branch of one of the oldest and most spectacular entertainment businesses in the world. At state fairs, charity carnivals, and seasonal festivals all over the country, these pyrotechnic showmen thrill millions of Americans annually. With dazzling bombshells, rockets, wheels, streamers, and animated pictures of chemical fire, in place of human actors, they produce thrilling extravaganzas as carefully worked out as any Hollywood movie or Broadway stage production.

At the 1940 New York World's Fair, fireworks dramatics blaze forth nightly as part of their biggest run in pyrotechnic history. In a total of 170 performances, more than 200 tons of fireworks, representing 2,000,-

000 separate units, and costing nearly \$300,000 will create constantly changing fire spectacles for millions of visitors. To learn at first hand how they are produced, POPULAR SCIENCE MONTHLY readers here go on an exclusive behind-the-scenes tour with Frank Duffield and Art Briese, director and technical manager respectively, of these super-productions at the New York fair.

Everything connected with the show must be done on a grand scale. Stretching 1,000 feet across the middle of Liberty Lake, 200 barges, floats, and motor boats outline the setting. Bristling from the barges, and connected by an intricate electrical wiring system, are 1,500 mortars, cannons of steel piping from which the bombshells are hurled into the air. Small floats carry sticks of colored fire, Roman candles, and gerbs—tubes of metal powder and chemicals which shoot forth fountains of gold and silver flame.

Although each evening's entertainment may last only fifteen or twenty minutes, forty experts—artists, carpenters, electricians, boatmen, and pyrotechnicians—work through the whole day getting the elaborate equipment in readiness. Mortars must be filled with the proper shells, wiring carefully checked, new set pieces

and animated pieces must be designed and built.

So that every effect may work in exact synchronism, all fireworks except pictorials and a few specialty numbers are fired by a single man stationed in a control room on the shore. Sitting at a desk overlooking the lake, he pushes buttons and switches that have been preset for each scheduled combination of fire and shells. By telephone he keeps in constant touch with control men on the barges. Wind is an important element in the presentation of a great fireworks spectacle. A high wind, blowing toward the spectators, often makes certain

From a control room overlooking the scene, the chief operator sets off hundreds of individual pieces. Right, bursting chrysanthemum shell



aerial bombs unsafe. When his wind velocity and direction indicator warns him, he merely flicks a switch and these parts of the program are dropped for the evening.

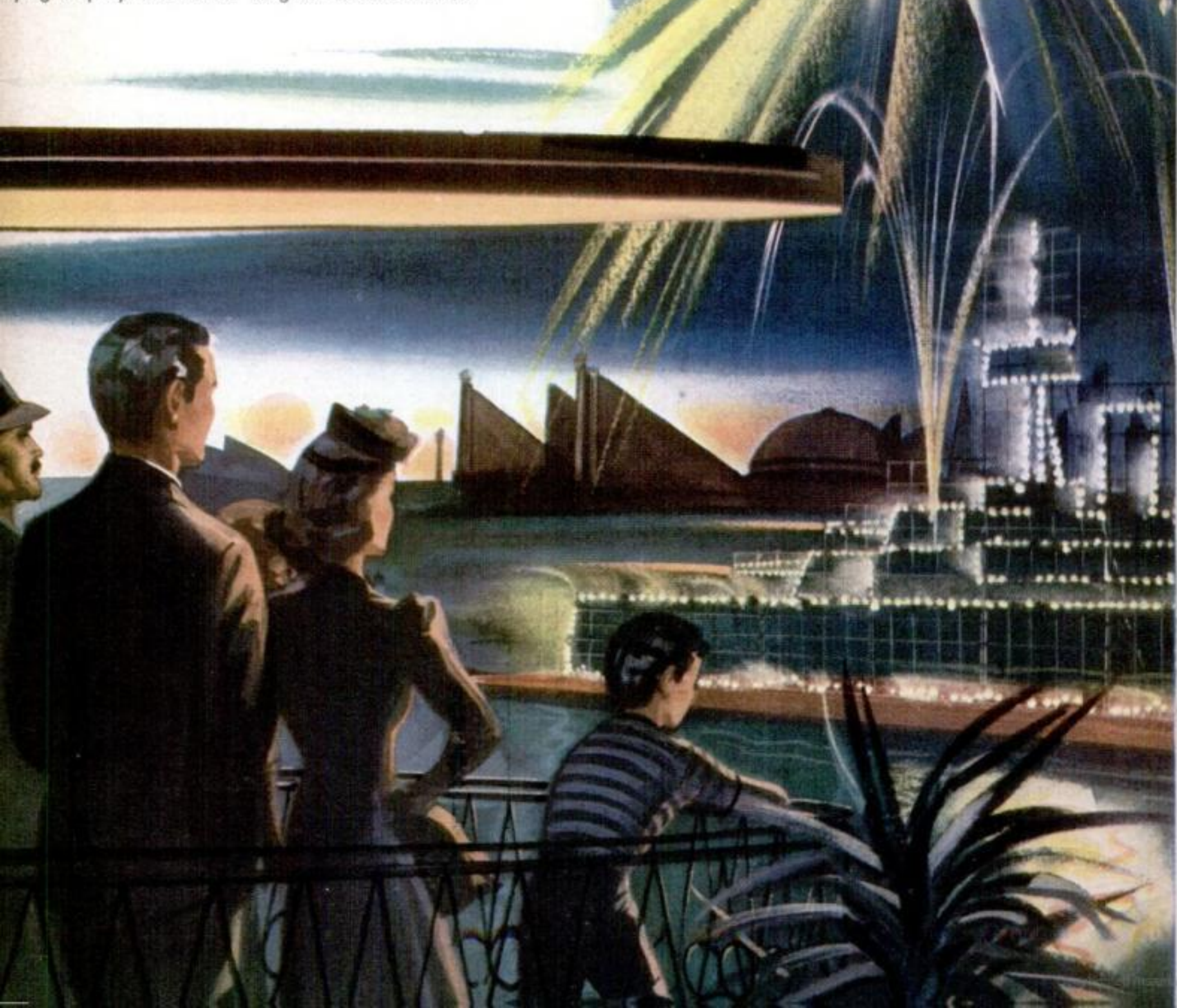
Newest feature of the fireworks dramatist is the animated pictorial, which represents news subjects of the day, such as aerial and sea battles, boat races, and prize fights. "Anything you can show me in photographs, I can reproduce in fireworks," is the boast of Duffield, and he proves it time and again by producing some big news event in vivid flame on the very night of the day in which it occurs.

The technique of making fireworks pictures has been reduced to an exact science. A photograph of the subject is ruled with squares, and the predominant outline traced. A larger drawing then is made to scale from the squared photo. This drawing is finally turned over to the "lance men" who copy the outline with strips of rattan, which

they nail on latticework frames of wood. Each frame is five by ten feet, and as many as are needed for a subject are laid out together. When the entire picture has been outlined, "lances," cigarette-like sticks of chemical-fire material, are attached to the rattan from four to six inches apart, by means of double-ended tacks. The outer ends of the lances are finally connected together with a fast-burning fuse.

Big lance-work pieces which must move as a whole, such as ships and railroad trains, are moved by towing the barges on

PAGEANT IN FLAME. Visitors to the New York World's Fair watch a thrilling spectacle showing battleships steaming past in review. Barges carrying displays are towed to give realistic motion

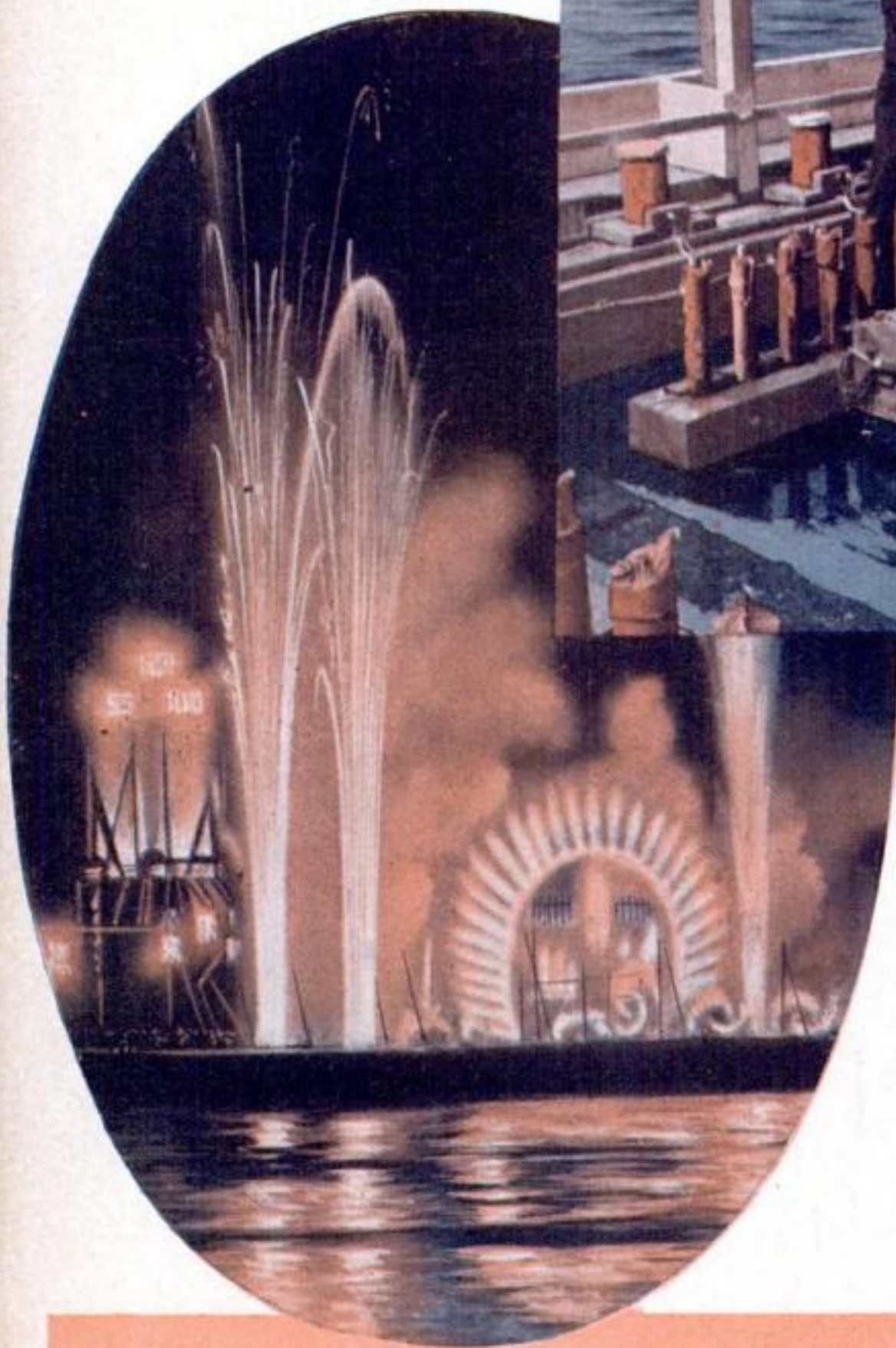




A corner of a barge, one of the 187 pieces of floating equipment used by the fireworks men. This one carries mortars of various sizes to fire shells that burst in air



A typical display is seen at left. Below, part of a fireworks plant, showing small, separate buildings where loading is done



which they have been set up. Novelty pieces, such as prize fighters, fishermen, harvesting machines, windmills, and so on, are built on special frames having movable joints and spinning wheels, which are operated manually by technicians.

Aerial bombs that burst from 300 to 1,000 feet in the air, breaking into dazzling chrysanthemums, willows, comets, stars, slithering snakes, and whirling fishes, alternate with pictorials to carry on the action in the sky. Comprising



more than 100 different effects, these bombs are masterpieces of the pyrotechnician's art. Shells carefully packed within shells, and timed to go off in proper succession with split-second accuracy, their secrets of construction are closely guarded by various manufacturers. They range from little ones, two or three inches in diameter, to giants a foot across, weighing up to fifty pounds, and costing up to seventy-five dollars each!

Color in these fireworks is produced by mixtures of metallic salts with potassium perchlorate or other oxidizing chemicals. Strontium salts produce red fire; barium, green; sodium, yellow; magnesium and aluminum, white; and, strangely enough, Paris green produces blue! The very latest in pyrotechnic bombs is the sodium cascade bomb, which throws out cascades of the brightest yellow light ever created for entertainment purposes.

Variety, breath-taking splendor, and rapid-fire action must be combined to draw "Ohs!" and "Ahs!" from the fireworks spectators. A program must be built up, effect upon effect, to a smashing climax.

A typical schedule begins with a huge set piece of George Washington, amid colored fire over the lake and star shells bursting in air. Follow in rapid succession huge silvery lily pads with pyrotechnic fish



Diagrams show the construction of three kinds of fireworks effects



This is a scene in a factory. The girl worker in the foreground is putting together a "tower of jewels" display

These men are carrying aerial bombs used in pyrotechnic spectacles. One has fast-burning fuses over his shoulder



of gold darting in and out of the water among them, displays of aerial bombs, golden forests, silver fountains, "gallopades" or giant wheels with golden fire spinning their rims and colored fire on their spokes, and silver fish that skim back and forth over the water.

Then comes the animated pictorial of the evening, a fleet review in New York Harbor. Against a background of a thirty-five-foot Statue of Liberty, fireworks ships—submarines, sub chasers, destroyers, cruisers, aircraft carriers, battleships—glide realistically across the lake. Stretched *(Continued on page 211)*

Private fireworks are sometimes elaborate, as this celebration for the Fourth of July on a country estate. At right, putting sticks on skyrockets. Natural light is used for safety



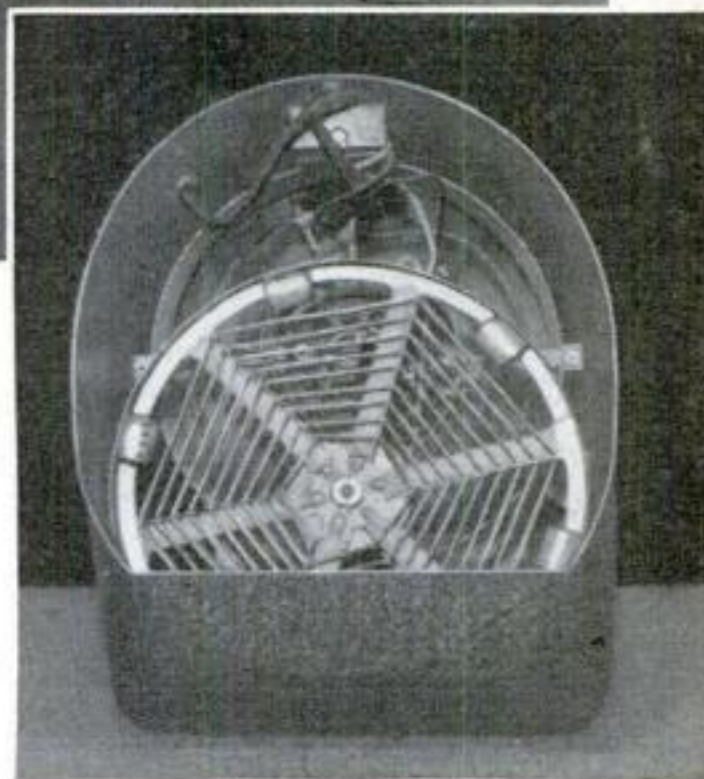
At the left is an assortment of "commercial" fireworks—the kind sold to the public for celebrations. They include skyrockets, Roman candles, pin wheels, and special effects

Water Cools Air in Portable Conditioner



Compact cooling unit in use in an office. At the right is the mechanism that passes air over water on a screen

WEIGHING only thirteen pounds, a portable air-conditioning unit just introduced circulates air cooled by the evaporation of water. Motor-driven brass buckets scoop water from a reservoir in the base and pour it onto a fiber-glass webbing. An electric fan behind the webbing blows the water-cooled air out into the room. A handle on top is convenient for carrying the unit from room to room.



Device Takes Iron Ore from Beach Sand

IRON ORE may be extracted from ordinary beach sand, according to Giovanni Liguori, inventor of a novel extraction machine said to have been tested successfully on the beach near Ostia, Italy. Sand is placed in a hopper and passed over a magnetic drum which picks up particles of iron oxide, while the sand itself is washed away by a stream of water. Many such machines may be built for use in areas where beach sand has a high iron content.



In this machine, a magnetic drum separates iron ore from ordinary sand

Plastic Airplanes

REVOLUTIONIZE AIRCRAFT DESIGN

PHENOMENALLY strong, unbelievably smooth, resistant to time and weather, impervious to water, fireproof, corrosionproof, and easy to fabricate—these are the outstanding claims made for new plastic airplanes being built at Van Nuys, Calif., by the Timm Aircraft Corp. Experts believe that the development may revolutionize the airplane industry and become one of the most potent factors in our national defense program.

For the new airplane, actually made of plywood impregnated and bonded with a phenol resin plastic, can be molded to

shape in a press. Parts of planes can be stamped out in only a fraction of the time that would be required to construct them of riveted or welded metal. And in a world racked by a conflict that has demonstrated the primary importance of airplanes as weapons of war, the rapid construction of military airplanes becomes a matter of vital significance, almost a matter of life or death. America can build motors faster than any

other country in the world—but you can't fly a motor by itself. Right there you come up against the bottleneck of the airplane industry, the problem of constructing metal wings and fuselage. Moreover, metal is expensive, heavy to transport, bulky to store.

By

R. DeWitt Miller



The first plastic plane to be turned out by mass-production methods, being tuned up for a test flight. At right, expert examining the smooth, molded tail surfaces of the new craft



In the air on a tryout spin. The body and wings are made of plywood impregnated with plastic. The plane weighs 1435 pounds

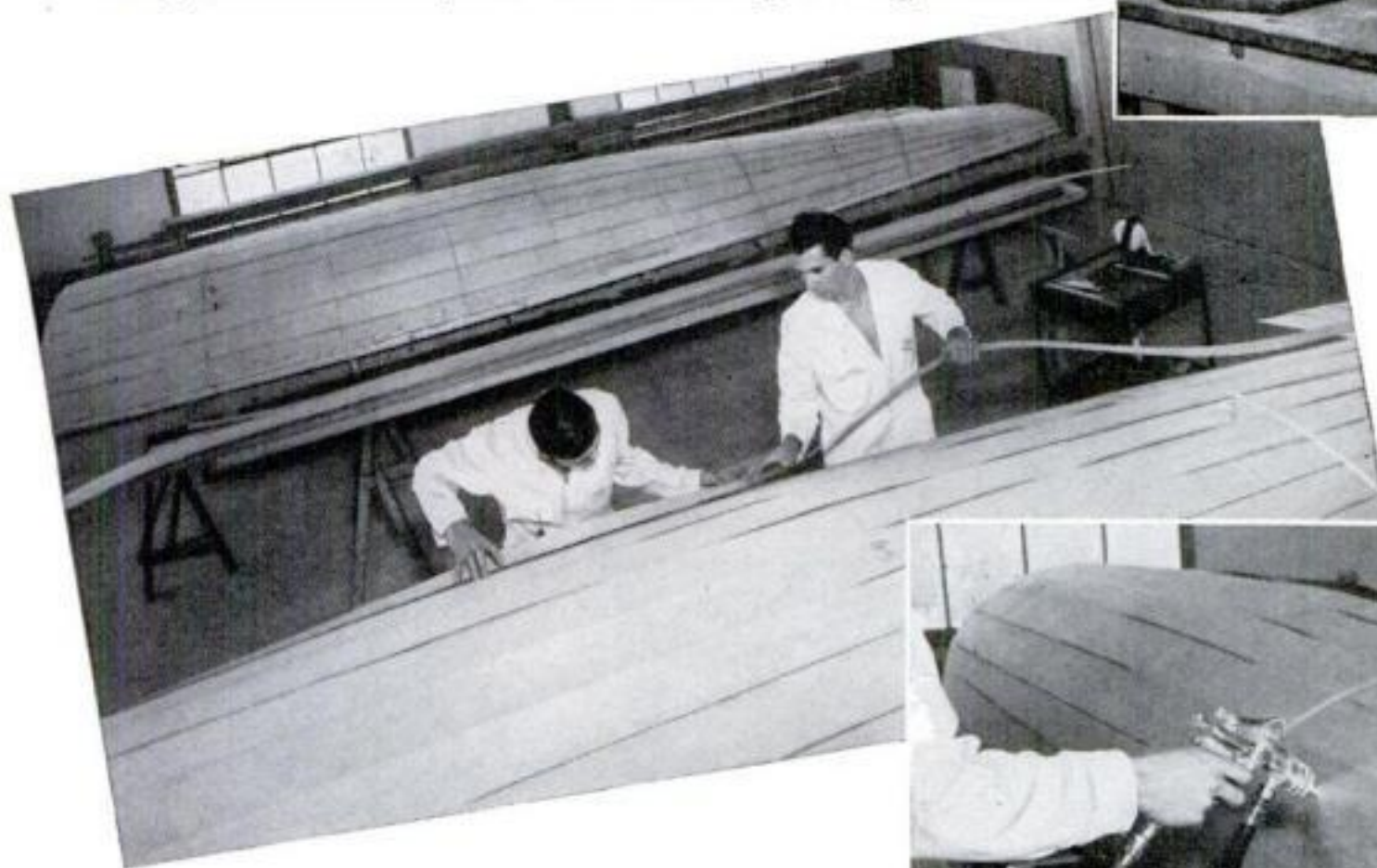
Planes of plastic and plywood would solve all these problems at one crack. They could be turned out in numbers that would stagger the imagination. The first such craft, which flew the other day near Los Angeles may, like the first locust, be the apparently insignificant forerunner of a great swarm.

But that's getting a little ahead of the story. Let's take a look behind the scenes and see just how plywood or "plastic" planes are built—and just what their military and commercial importance is likely to be.

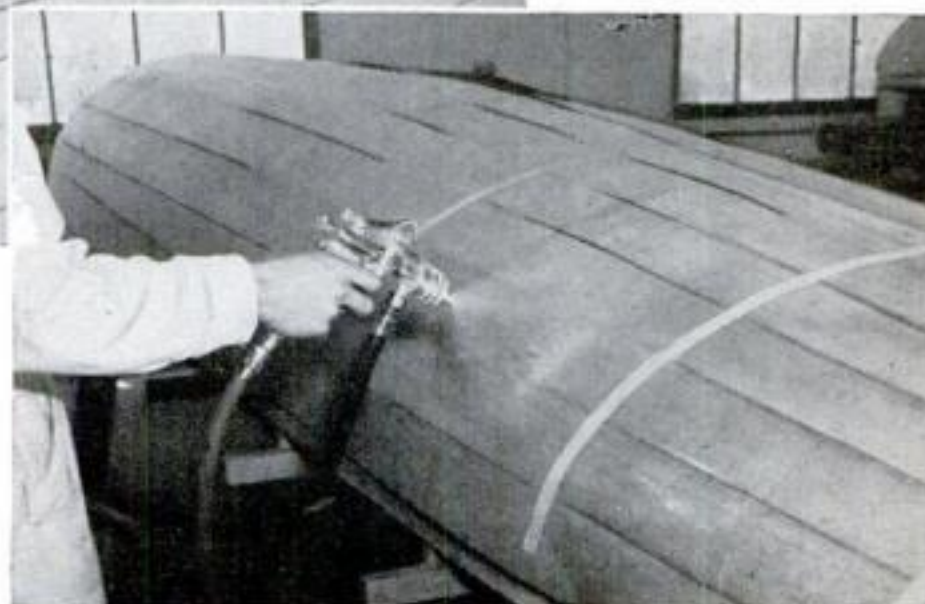
As things stand now, two plants in the United States are producing such planes on an experimental basis. No military aircraft have yet been completed, but several experimental models are almost ready for testing. Nothing approximating mass production has yet been attempted. The first ship to be produced



Mixing ingredients that form the liquid phenol formaldehyde resin used for plane construction. This is a plastic similar to well-known bakelite

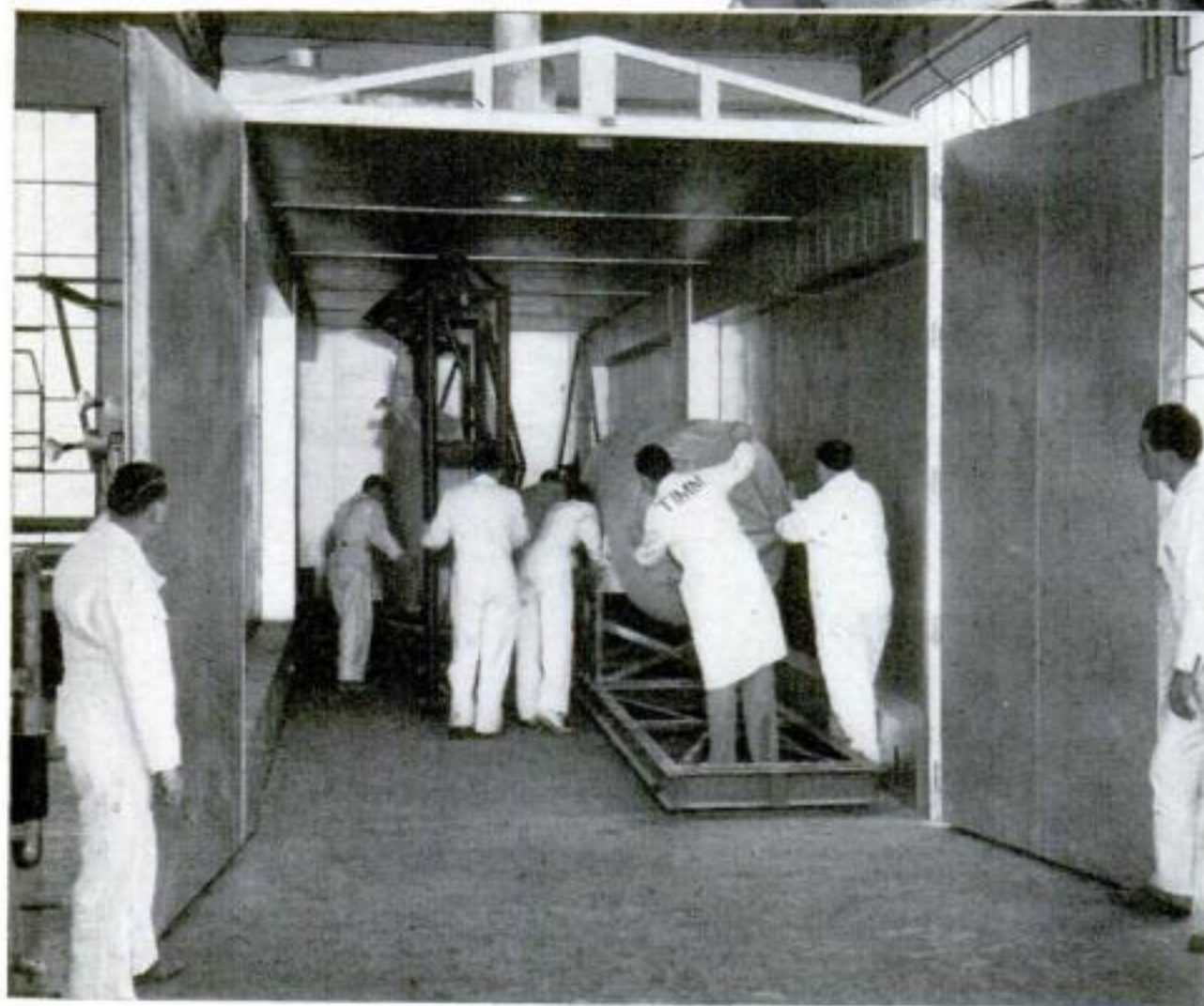
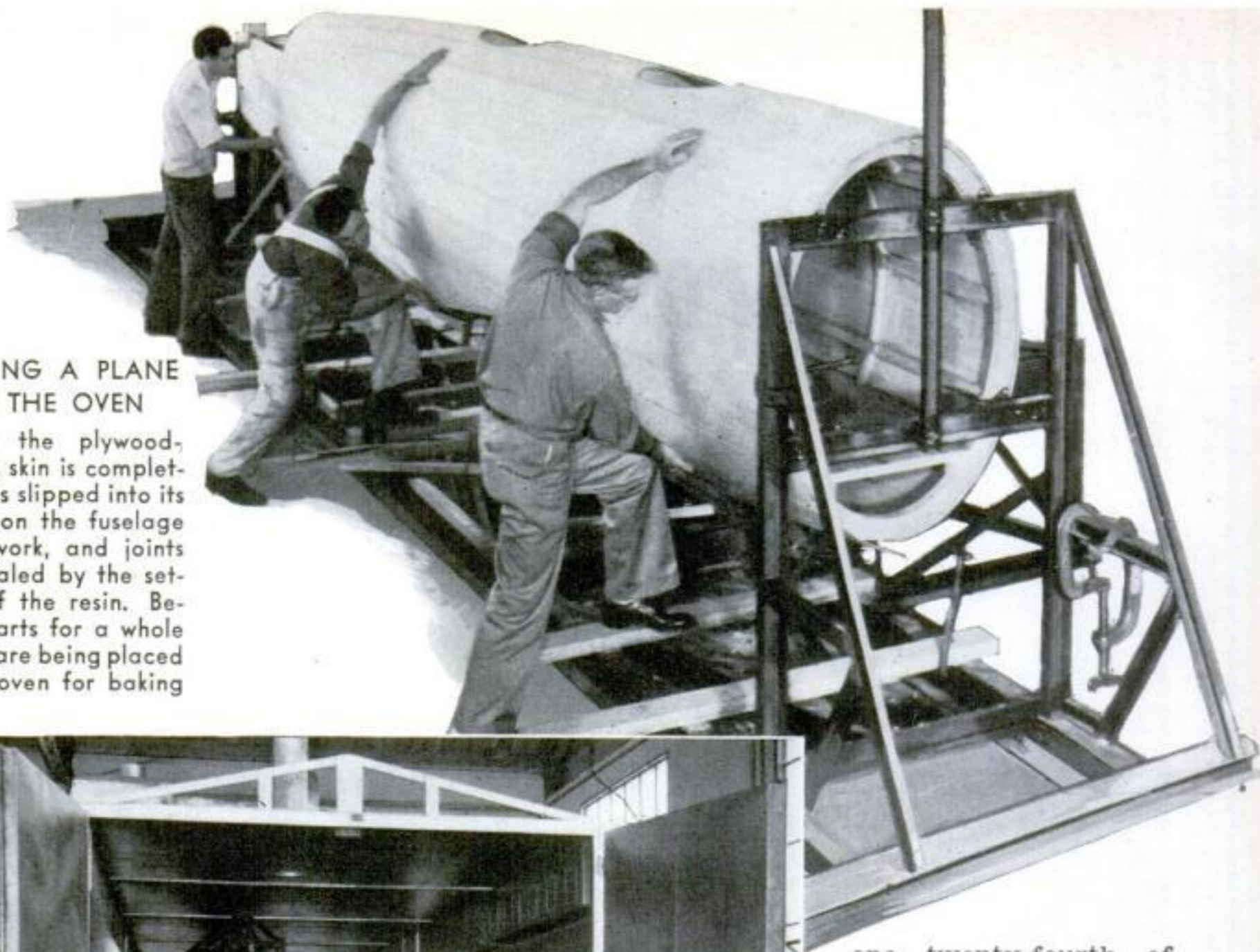


Workmen applying thin layers of spruce plywood to form a fuselage. These are held in place by masking tape until the bonding operation, which consists of spraying on the plastic as at right



PUTTING A PLANE IN THE OVEN

When the plywood-plastic skin is completed, it is slipped into its place on the fuselage framework, and joints are sealed by the setting of the resin. Below, parts for a whole plane are being placed in an oven for baking



one twenty-fourth of an inch thick, are arranged to form three plies, or layers, the grain of the center ply being at right angles to that of the top and bottom plies, as in common plywood.

Next the plies are sprayed with a phenol resin plastic compound whose composition is similar to bakelite. This takes the place of the glue used in ordinary plywood. But instead of being applied only to the surface of the

by practical mass-production methods was the one flown near Los Angeles. It is a two-seater, open-cockpit, training model powered by a 160-horsepower motor and capable of a speed of 140 miles an hour.

There is nothing in the methods by which that plane was built, however, which cannot be applied to high-speed streamline production. Briefly, the method of construction consists of a half dozen steps.

First a half shell of each essential section of the plane is built up on a jig. Strips of spruce, which are the full length of the section being formed, a few inches wide, and

wood, as in the case of glue, the plastic is forced into the cells of the wood.

After the plastic binder sets, the rough shell is placed in a mold which is the exact size and contour desired. Pressure is then applied, forming the shell to the precise shape, and at the same time fusing the plastic compound with the wood, so as to form a completely new substance. The method of forming which seems to have the greatest practical advantage uses cold pressure, thereby eliminating the problem of constructing complicated heated presses.

When a plywood-plastic shell comes from

the press, it is smooth and almost metallic in appearance. It is then placed on a huge jig which has the form of a large section of the plane, such as the fuselage or wings. The plywood-plastic "skins" which are to cover each section of the plane are then arranged in place, as if they were die-stamped sheets of metal. But instead of being riveted together, the joints are simply sprayed with additional plastic. When this sets, the joint is as strong as the material.

THE plane has now been formed in several large sections. These sections include the entire fuselage, the wings, and the tail surfaces. These sections are given a final spray of plastic, then placed in a gigantic oven where they are baked at temperatures varying from 180 to 240 degrees. This heat finally sets the separate plywood-plastic "skins" into a single mass without seams.

To complete the plane, it is only necessary to attach the wings to the fuselage with simple couplings, to assemble the tail surfaces, and to mount the motor in place with swiftly completed attachments. Interior construction, including controls and seats, has already been completed while the fuselage was on the jig. This is a simple operation, as the installation is done when only one of the two shells forming the fuselage is in place.

The plane is now ready to fly. It has been built with only a fraction of the labor

necessary for metal construction. The material is far cheaper, much more available. It is twenty percent lighter than metal, and is far more resistant to fire. Elimination of all external roughness, such as rivet heads and joints, gives increased speed potentialities of up to twenty-five percent.

But what of the other side of the picture? Are there any outstanding faults to this method of construction? Are there "bugs" which would interfere with its use for military airplanes?

There is one major defect of the plastic plane, but apparently it would only become serious in certain types of operations. It is the fact that plywood-plastic planes are difficult to repair. *(Continued on page 214)*



Molded to a precision fit, wing and tail surfaces are lifted into position and fastened securely. In circle, a blowtorch test compares fire-resisting qualities of plastic (right) and duralumin

Transparent Covers Guard Pages

Inserting pages in transparent protective covers for use in a salesman's sample book



TO PROTECT and preserve documents, photographs, legal forms, notebook pages, and other important papers that are subject to frequent handling, a New Jersey manufacturer has introduced page covers made of transparent rubberized material. Odorless, non-inflammable, and waterproof, the page covers are made in five different sizes and can be punched along the open ends so they will fit in loose-leaf books.

Robot Composer of Music Knows 65,000 New Tunes

MUSIC created through the use of mathematical formulas is the idea promulgated by Joseph Schillinger, New York City composer, lecturer, and author. One unusual instrument which he employs for the purpose, called a Rhythmicon, is pictured in the photograph at the right. By reference to a mathematical chart previously prepared, Schillinger sets keys and controls on the instrument so that it is made to produce rhythmic beats as a basis for forming a musical composition. By changing the combination, more than 65,000 original compositions can be produced, it is said.



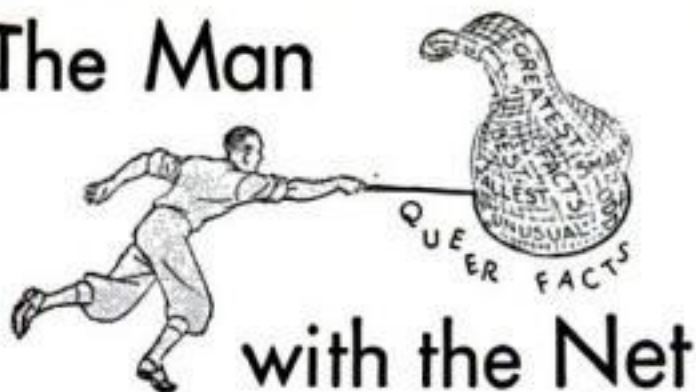
Joseph Schillinger with the mechanical composer

Nonslip Belt-Pulley Cover



ALTHOUGH invented more than forty years ago, an adhesive material for preventing machine belts from slipping on pulleys has just been marketed on a commercial scale. The product is made in sheets, which are torn into strips of the proper width and lapped around the pulley after soaking in hot water. The pulley covering eliminates practically all belt slippage, the maker declares.

The Man



with the Net

HEATING SYSTEMS on modern airliners are large enough to warm ten-room houses.

HORSETAILS, primitive plants growing in swamps, are poisonous to horses.

BIRDS, like airplanes, take off into the wind.

HONEY 3,300 years old, found in the tomb of an Egyptian monarch, is said to have retained its characteristic aroma.



AMERICAN INDIANS are in special demand as structural-steel workers because of their ability to walk beams without becoming dizzy.

POLONIUM, worth 57,000 times as much as gold, is being used in the electrodes of a new spark plug.

BULL ELEPHANTS, weighing five tons, can charge at a speed of twenty-five miles an hour.



SEVENTEENTH CENTURY maps of North America showed California as an island.

PLASTIC clothespins, tinted in pastel shades, have been introduced by a Detroit, Mich., inventor.

ONE HUNDRED THOUSAND New York City pupils, on the average, are absent from classes each school day.



The unit consists of a solid wooden top, a knife, and a folding stand



Meat Chopper for Picnics

DESIGNED for outdoor use at large picnics or barbecues, a meat carving and chopping block standing twenty-eight inches high folds up for carrying. The block itself is of maple and the folding legs of steel.

Handy Fiber Shoe-Trees

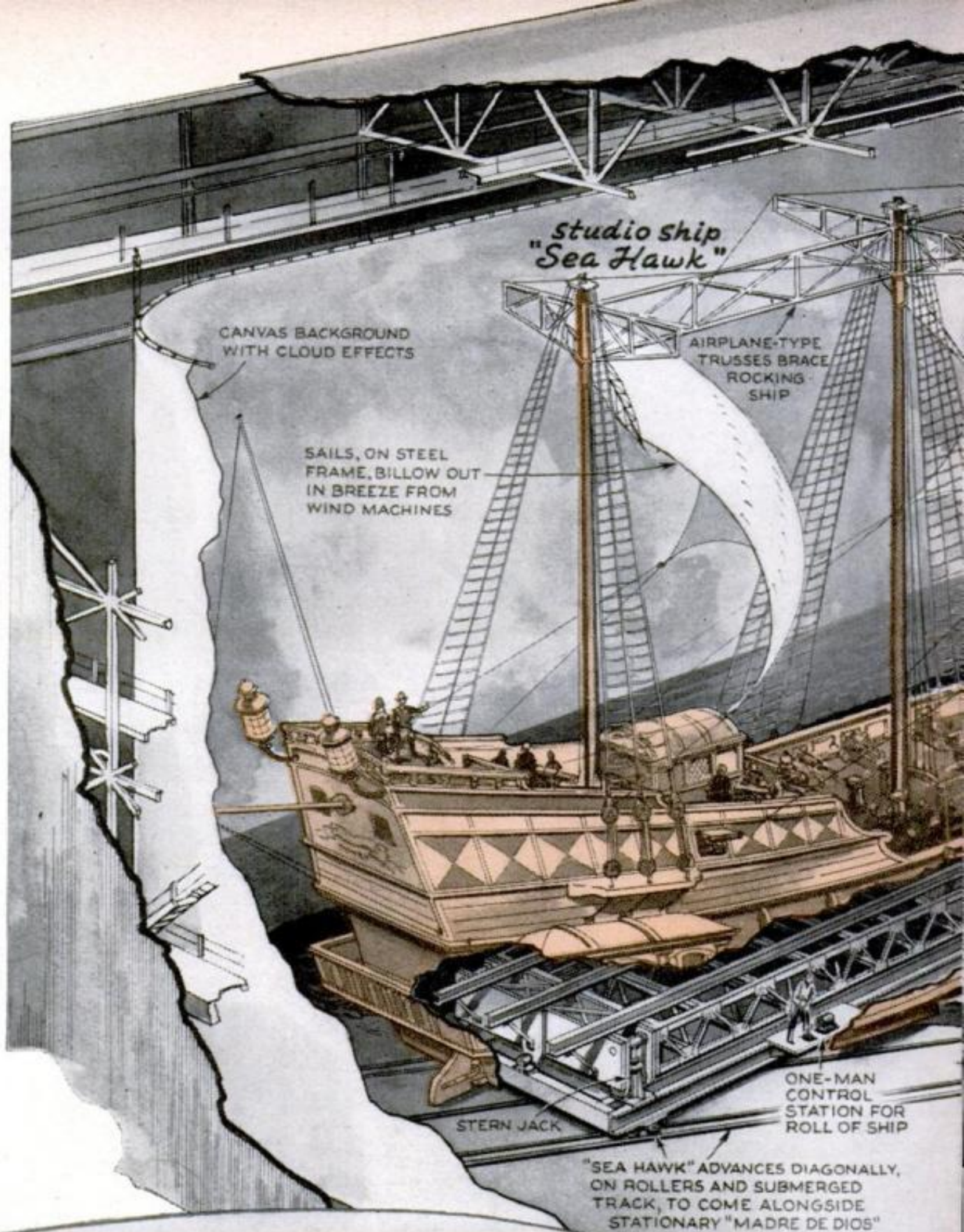
FITTING neatly into a compact carrying case, sheets of fiber material now on the market can be bent to serve as shoe-trees, as shown below. A unique method of construction maintains them in a rigid position.



When not in use, the shoe-trees fit in a flat case

By
**ANDREW R.
BOONE**

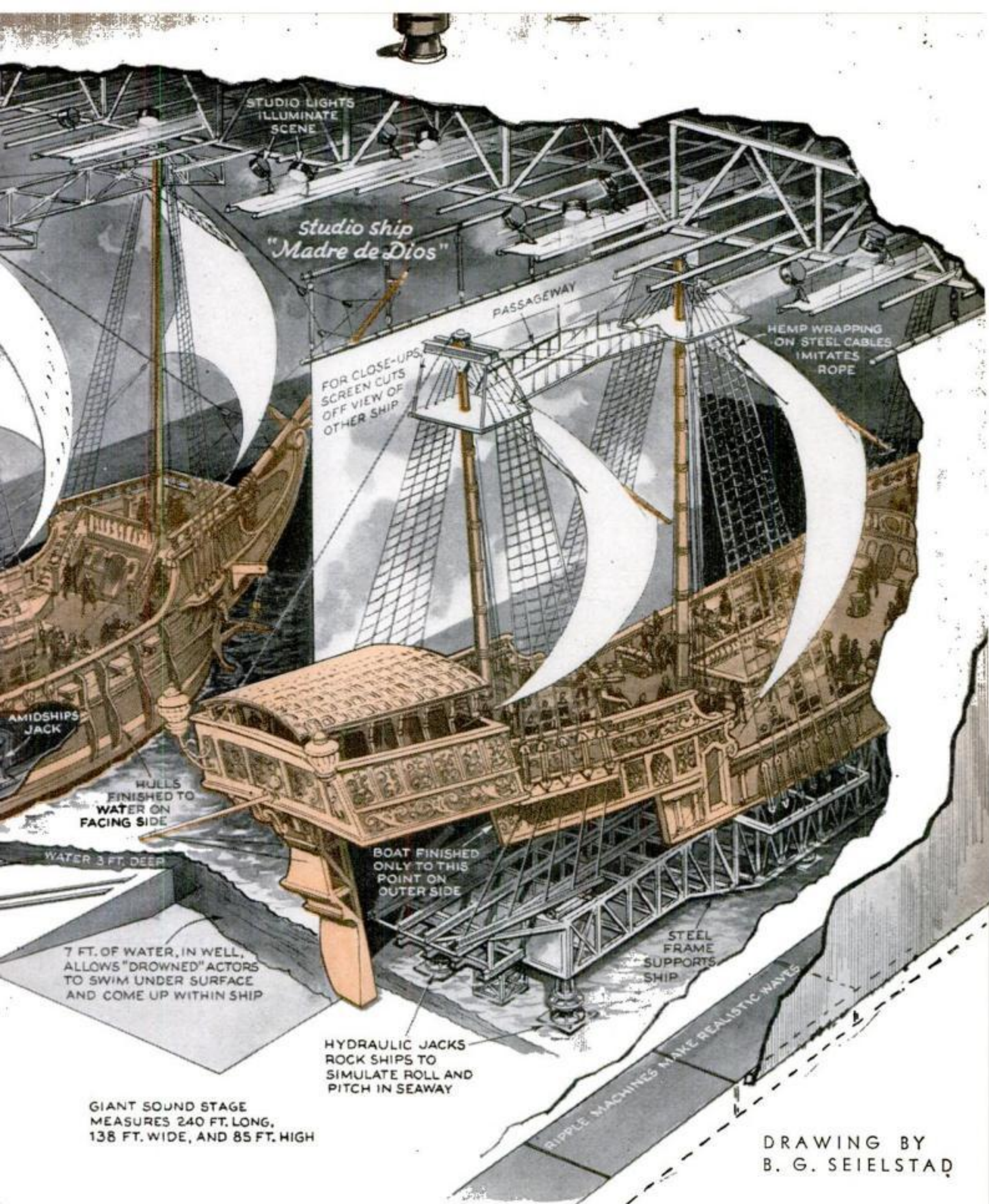
Pitching and
Rolling on an
Indoor Ocean,
Copies of
Famous Vessels
Fight Old-Time
Naval Battles
on One of
Hollywood's
Newest
Sound Stages



Movie Ships Sail Studio Seas

FULL-SIZE copies of historic ships, with live actors aboard, enact thrilling dramas of adventure on a Hollywood movie sound stage nearly as large as a football field. A make-believe ocean, only three feet

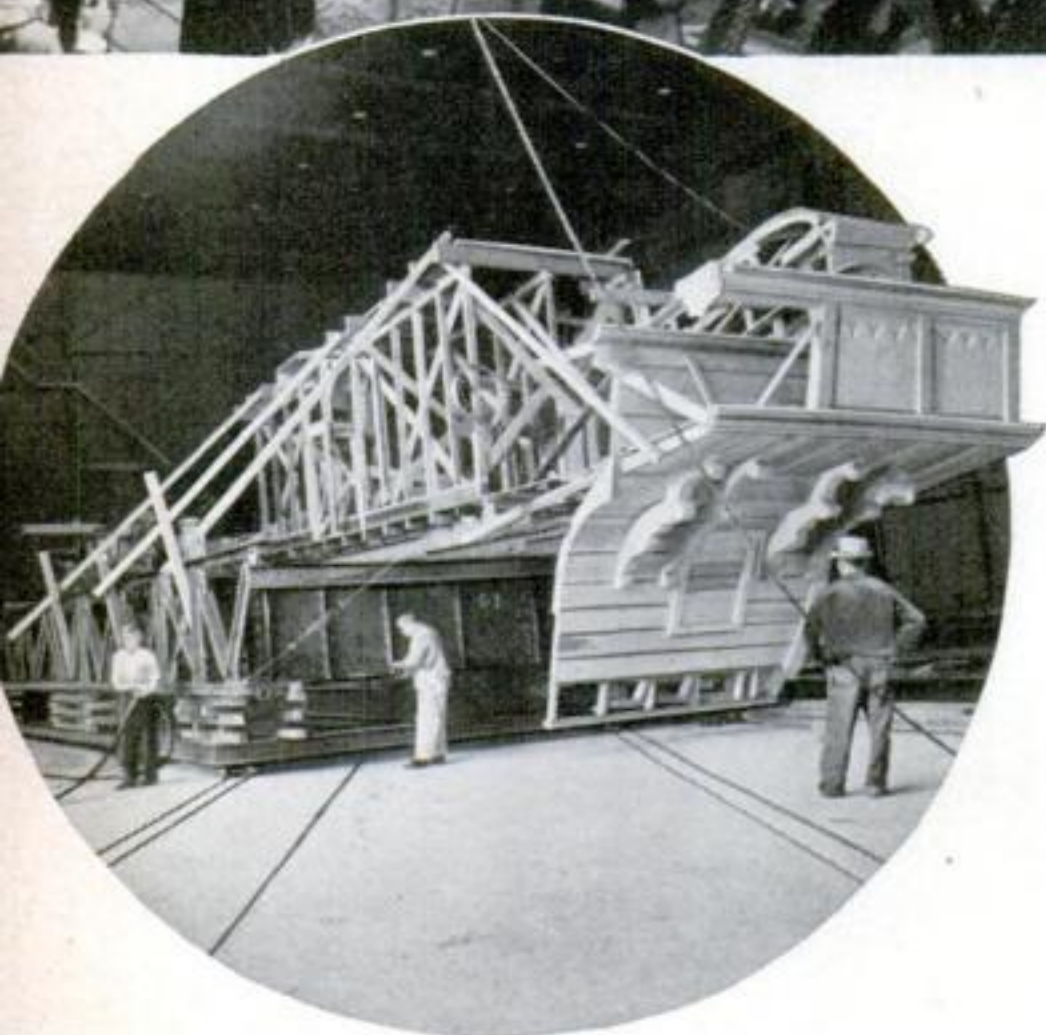
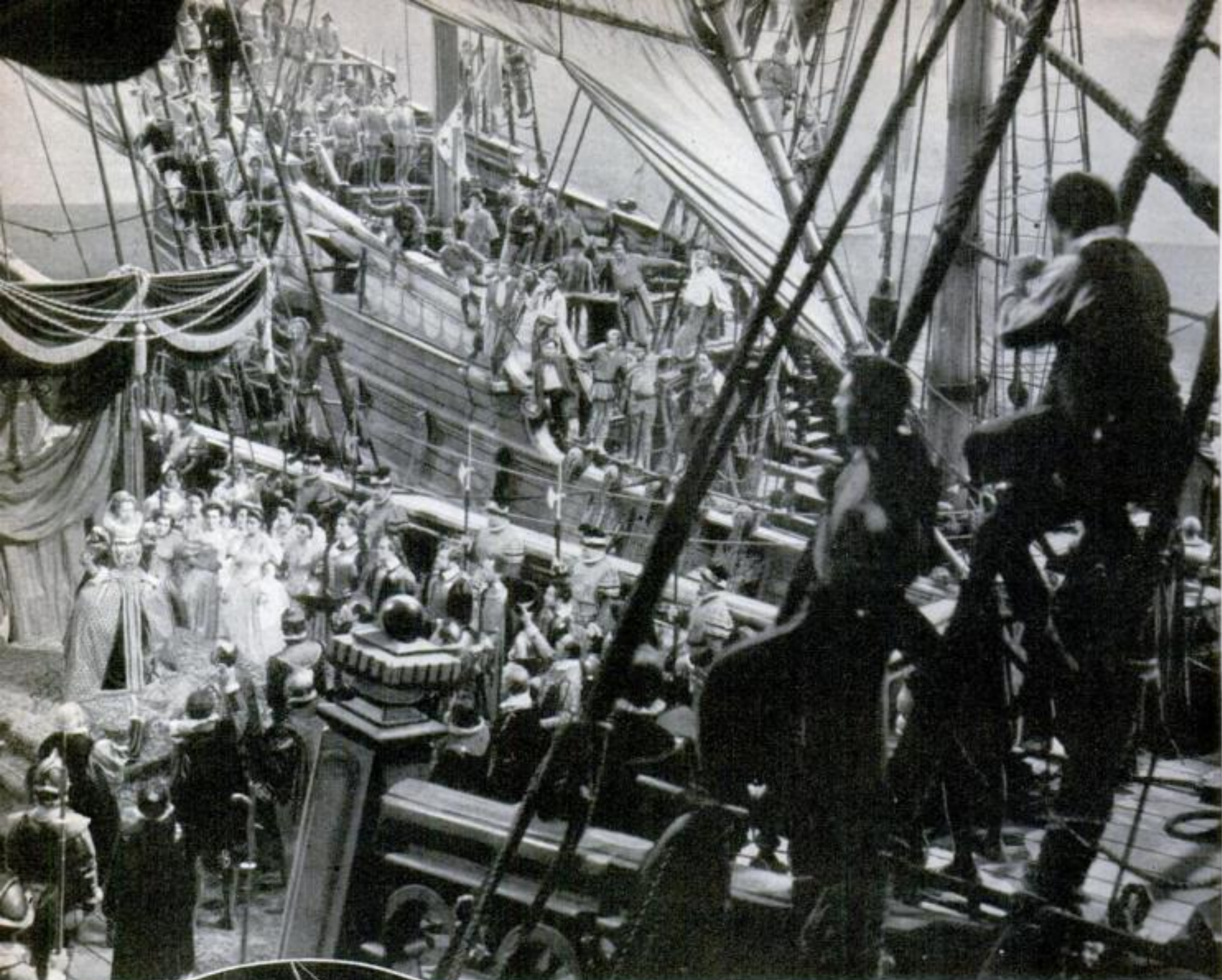
deep, shimmers around the vessels, and a 600-foot drapery provides a background of sky and clouds. But what imparts the final touch of realism is a battery of ingenious machines, outside of camera range, which



impart life and movement to the big scene.

Hydraulic jacks make the big boats pitch and roll, as they ride at mythical anchor or ply the "sea." Exciting maneuvers are performed as power-operated cables tow the ships, on wheels, along submerged tracks. Wind machines fill the sails that seamen rig and set before the eye of the camera, and wave machines produce anything from a gentle swell to a storm.

At a cost of \$250,000, the new stage and two vessels were recently constructed at the Warner Brothers studio for filming "The Sea Hawk." One ship, the *Sea Hawk* itself, is a reproduction of the *Golden Hind* which Sir Francis Drake, British naval hero, sailed around the world in 1577-80. It measures 150 feet long. Even larger is the 180-foot *Madre de Dios*, a Mediterranean type of the same period. Later on, for future films,



A scene in "The Sea Hawk," filmed on a vast studio stage. Reproductions of historic ships rest on steel carriages like that at the left, which move on tracks beneath a shallow "sea"

Guns roar with the explosion of blank ammunition. Actors fall overboard and "drown," actually descending into a well seven and a half feet deep, and emerging unseen through the bottomless hull of the vessel.

During the scene, the *Sea Hawk* closes in and comes up beside the *Madre de Dios*, exactly as in a sea maneuver for boarding. To provide this effect, cables attached to motors draw the attacker along a diagonal track, so that the *Sea Hawk* advances sixty-five feet while drifting sideward twenty-five feet. Thus it appears to overtake the *Madre de Dios*, permanently fixed in one spot.

Six hydraulic jacks give each ship its rolling motion. Mounted on a steel supporting cradle, three of the jacks bear on each side of the boat's framework. By reversing the direction of fluid in the pipes leading to the jacks, port and starboard sides are lifted alternately, giving more than three feet of vertical movement at the rail of the *Madre de Dios*. Bow and stern jacks give an independent pitching movement, making

other craft of any type may be constructed and "navigated" upon the same stage.

In the present movie production, the *Sea Hawk* is shown attacking the *Madre de Dios*. Manned by trained crews totaling about 300 men, the two vessels carry twenty-four cannon and 1,000 eight-pound shot.

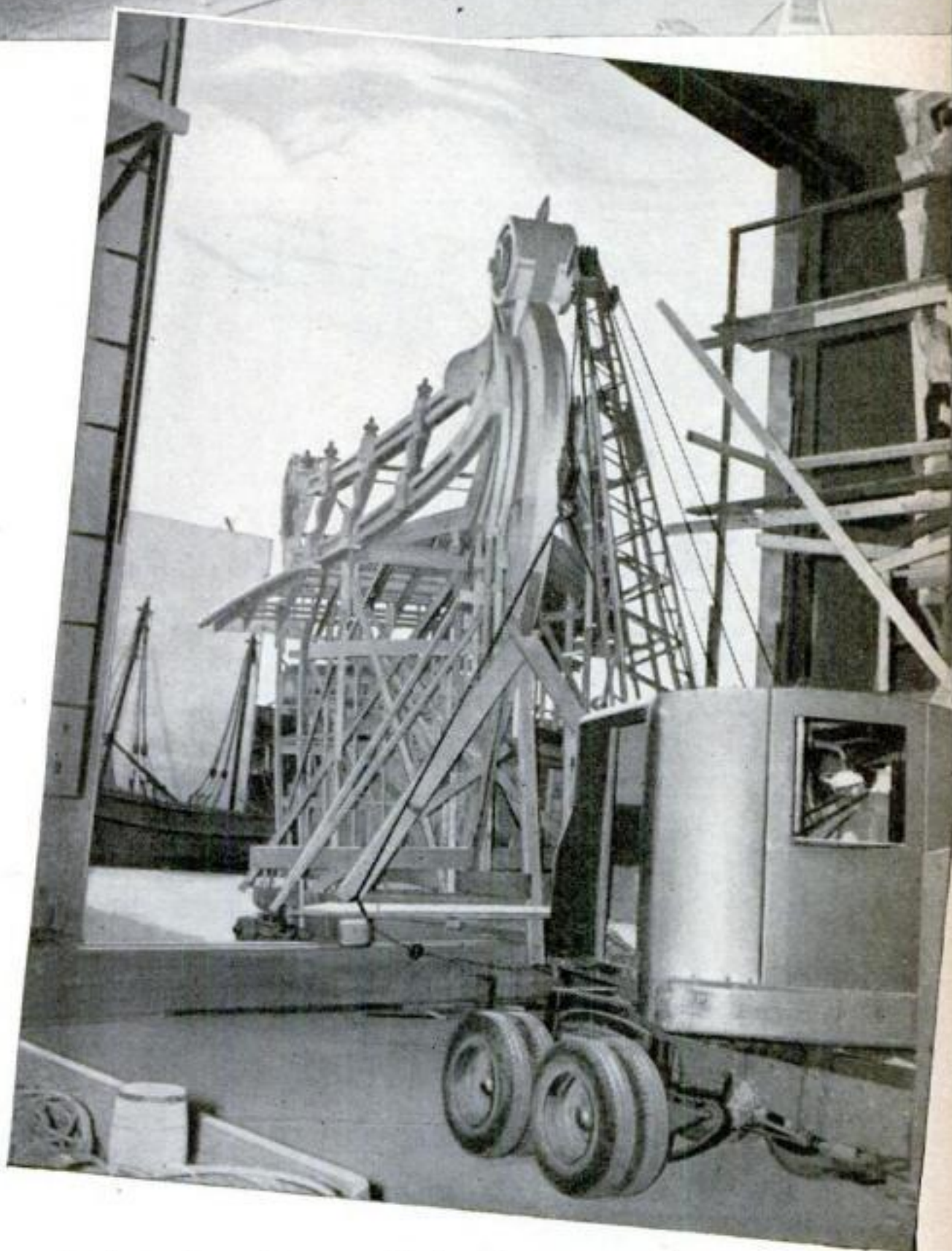
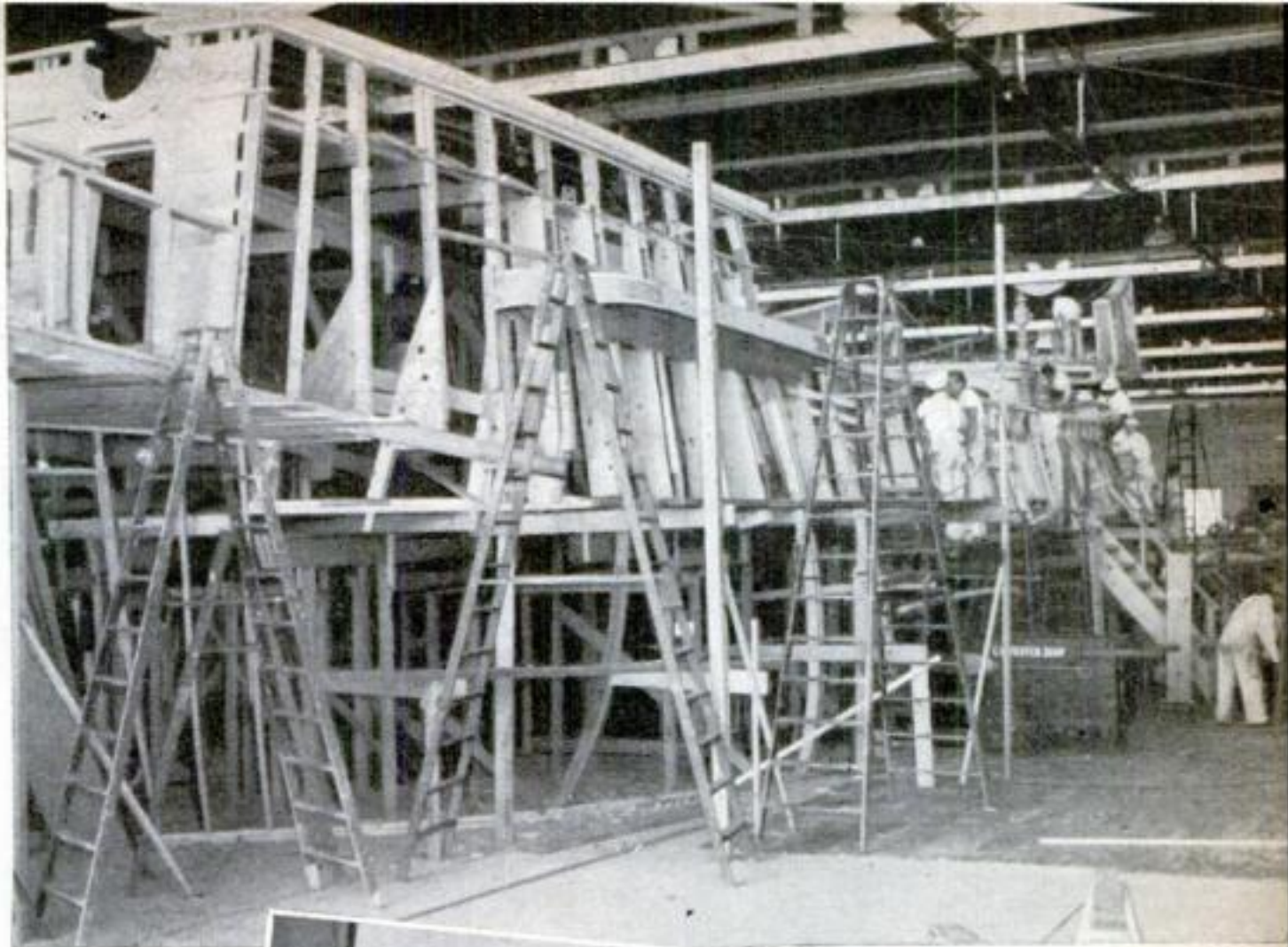
the ship seesaw fore and aft over the amidships jacks. Above the level of the camera's vision, airplane-type trusses of steel connect the masts to brace the whole structure. They also support side bracing cables of steel, covered with hemp to imitate rope.

Designed by Anton Grot, art director, the ships were built in sections, which were towed onto the stage and then bolted together. Fifteen separate sections went into the assembly of the *Sea Hawk*, while the *Madre de Dios* required twenty-five.

When ready for action, exclusive of people and picture equipment, the *Sea Hawk* loads 140 tons on the jacks; and the *Madre de Dios*, 200 tons. Each rises sixty-six feet, or the height of a five-story building, from the jacks to the tops of its masts. Authentic furnishings for cabin interiors have been patterned after museum pieces.

When thwart-ship close-ups are to be staged, the ship in the background may be blocked off by suspending tall screens from the top of the stage. On the sides facing each other, where the cameramen work, each vessel has been finished to just below the water line; but their outer sides, only partly sheathed, expose the gaunt underpinning and the cleverly controlled machinery that gives them life.

According to the designers, the new scheme of filming sea thrillers on studio ships represents a marked advance in movie technique. Not only does it save the construction cost of seagoing vessels and the time for long voyages off the southern California coast. Still better, it affords the camera technicians all the advantages of equipment fully under their control, with no vagaries of nature to interfere with lighting effects and other necessary arrangements. So aided, their results appear more real than reality itself.



Each vessel was first assembled in the carpenter shop seen in the upper picture, then cut into sections for transfer to the sound stage. Above, a mobile crane is dragging one of the finished sections to its place on the studio set

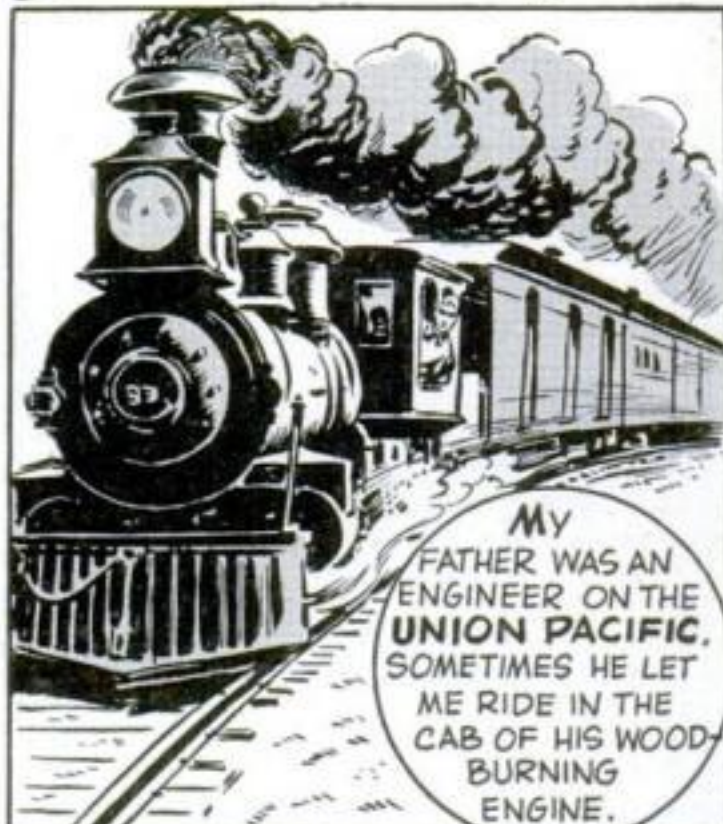


Here's My Story

I WAS BORN ON APRIL 2, 1875, IN THE TINY TOWN OF WAMEGO, KANSAS. THERE, ON THE FRINGE OF PLAINS CIVILIZATION, EVERYBODY LIVED IN FEAR OF INDIANS. CUSTER MADE HIS LAST STAND JUST NORTH OF US WHEN I WAS ONE YEAR OLD....



I REMEMBER, WHEN I WAS FIVE, ANOTHER BOY SHOUTED "INDIANS ARE COMING!" SCARED STIFF, I RACED HOME TO HIDE IN OUR CYCLONE CELLAR...



MY FATHER WAS AN ENGINEER ON THE UNION PACIFIC. SOMETIMES HE LET ME RIDE IN THE CAB OF HIS WOOD-BURNING ENGINE.



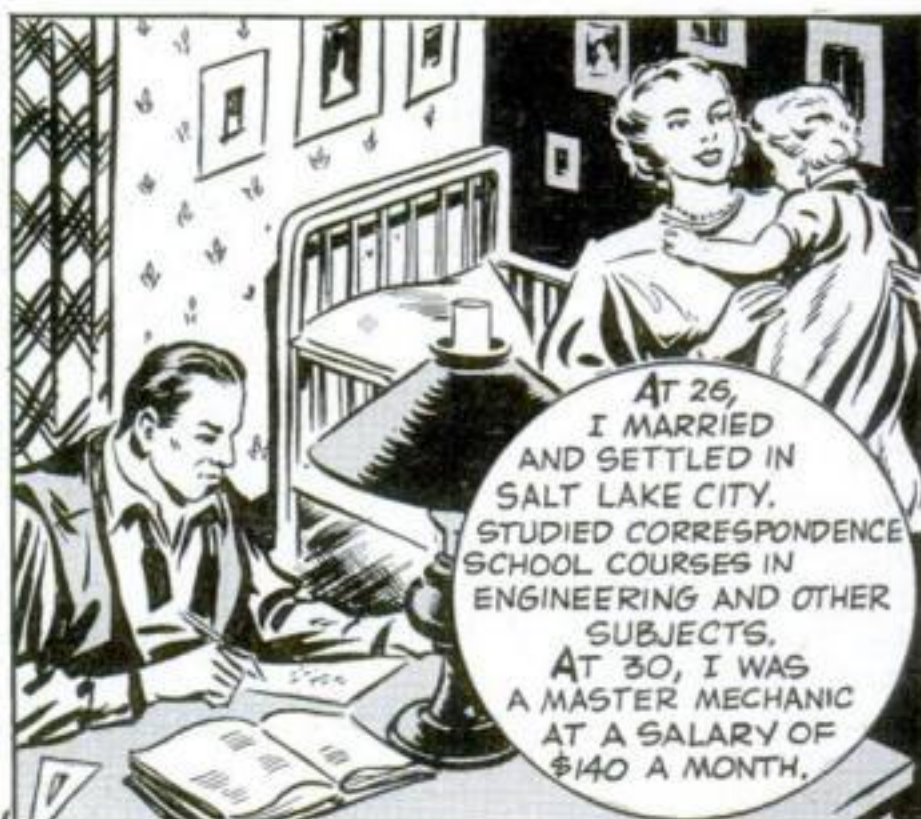
ALTHOUGH MY FATHER WANTED ME TO GO TO COLLEGE, I LOVED MACHINERY AND BECAME A MACHINIST'S APPRENTICE IN A RAILROAD SHOP. I MADE MY OWN TOOLS. (THESE ARE NOW DISPLAYED IN THE CHRYSLER BUILDING, N.Y.C.)



I PLAYED THE TUBA IN THE SHOP BAND. OUR UNIFORMS WERE SIMPLY OVERALLS AND CAPS WITH RED BANDANNAS AROUND OUR NECKS. HALF THE TOWN WOULD LINE UP TO HEAR US. IT WAS SWELL FUN....



WHEN I HAD SERVED OUT MY APPRENTICESHIP, I QUIT AND ROAMED ALL OVER THE WEST, OFTEN RIDING THE RAILS, WORKING IN SHOPS ALL OVER THE ROCKY MOUNTAIN AREA....

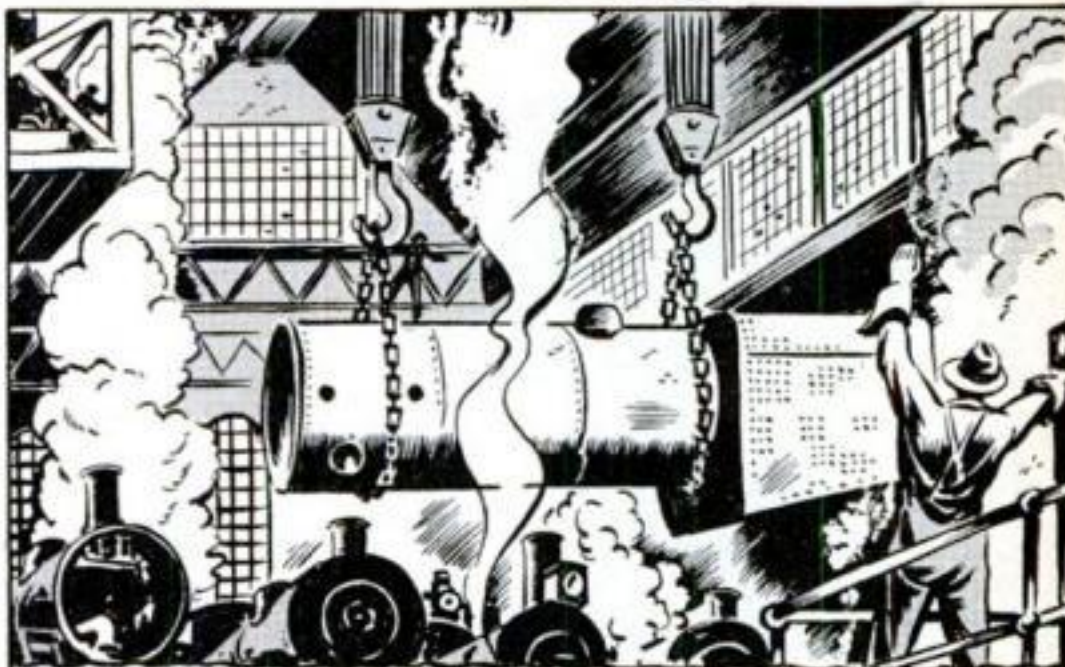


AT 26, I MARRIED AND SETTLED IN SALT LAKE CITY. STUDIED CORRESPONDENCE SCHOOL COURSES IN ENGINEERING AND OTHER SUBJECTS. AT 30, I WAS A MASTER MECHANIC AT A SALARY OF \$140 A MONTH.

From SHOP HELPER to CAPTAIN of INDUSTRY *by Walter P. Chrysler*



IN 1908, I BORROWED \$4,300 TO ADD TO MY \$700 SAVINGS, AND BOUGHT A \$5,000 LOCOMOBILE CAR. TO STUDY ITS OPERATION, I TOOK IT APART AND REASSEMBLED IT MANY TIMES BEFORE I FIRST DROVE IT.



I QUIT RAILROADING AT OELWEIN, IOWA, AFTER A QUARREL WITH THE PRESIDENT OF THE ROAD AND WENT TO PITTSBURGH TO TAKE A JOB AS SHOP SUPERINTENDENT FOR THE AMERICAN LOCOMOTIVE CO. THERE WE BUILT ALL KINDS OF ENGINES.

IN 1912 I ACCEPTED AN OFFER TO BE WORKS MANAGER FOR THE BUICK MOTOR CO. AT FLINT, MICH. AT \$6,000 A YEAR, ALTHOUGH I WAS GIVING UP A \$12,000 SALARY AT PITTSBURGH. I LOVED AUTOMOBILES!

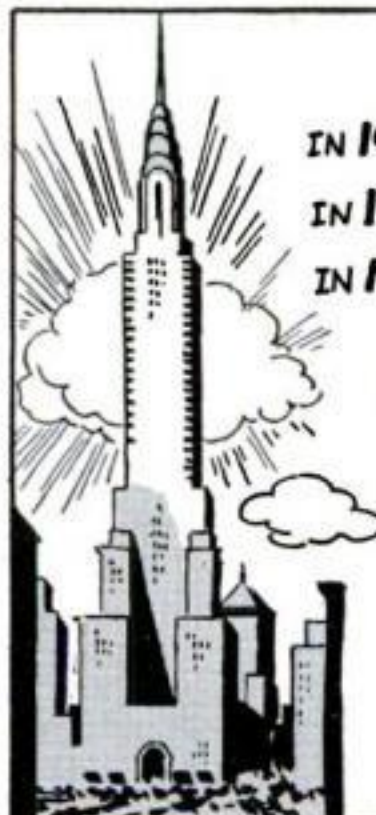
IN 1916 I BECAME PRESIDENT & GENERAL MANAGER AT BUICK. WHEN I LATER CONSIDERED ANOTHER JOB, BUICK OFFERED TO PAY ME \$500,000 A YEAR TO STAY. I STAYED



WHEN I WAS 45, I QUIT BUICK AND DECIDED TO RETIRE. BUT THE WILLYS OVERLAND AUTOMOBILE CO. OFFERED ME \$1,000,000 YEARLY SALARY TO HELP THEM REORGANIZE...



NEXT I HELPED REORGANIZE THE MAXWELL MOTOR CORP., AND WORKED WITH 3 YOUNG ENGINEERS ON A NEW TYPE OF CAR — THE FIRST CHRYSLER..



IN 1927 CHRYSLER WAS FIFTH IN THE INDUSTRY..

IN 1928 CHRYSLER CORP.

BOUGHT DODGE
IN 1929 THE CHRYSLER BLDG.
IN NEW YORK CITY
WAS BUILT.

NOW, THE CHRYSLER CORP.
LINE HOLDS SECOND PLACE
IN THE NUMBER OF
PASSENGER CARS PRODUCED

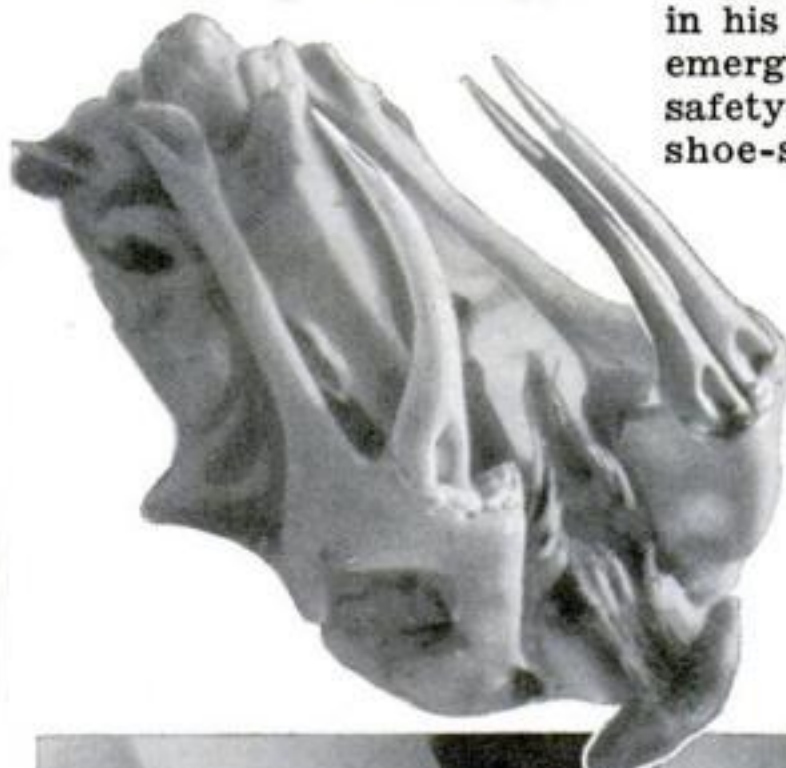
and
WALTER P. CHRYSLER
IS CHAIRMAN OF THE BOARD
OF THE CORPORATION...

Snake Dentist

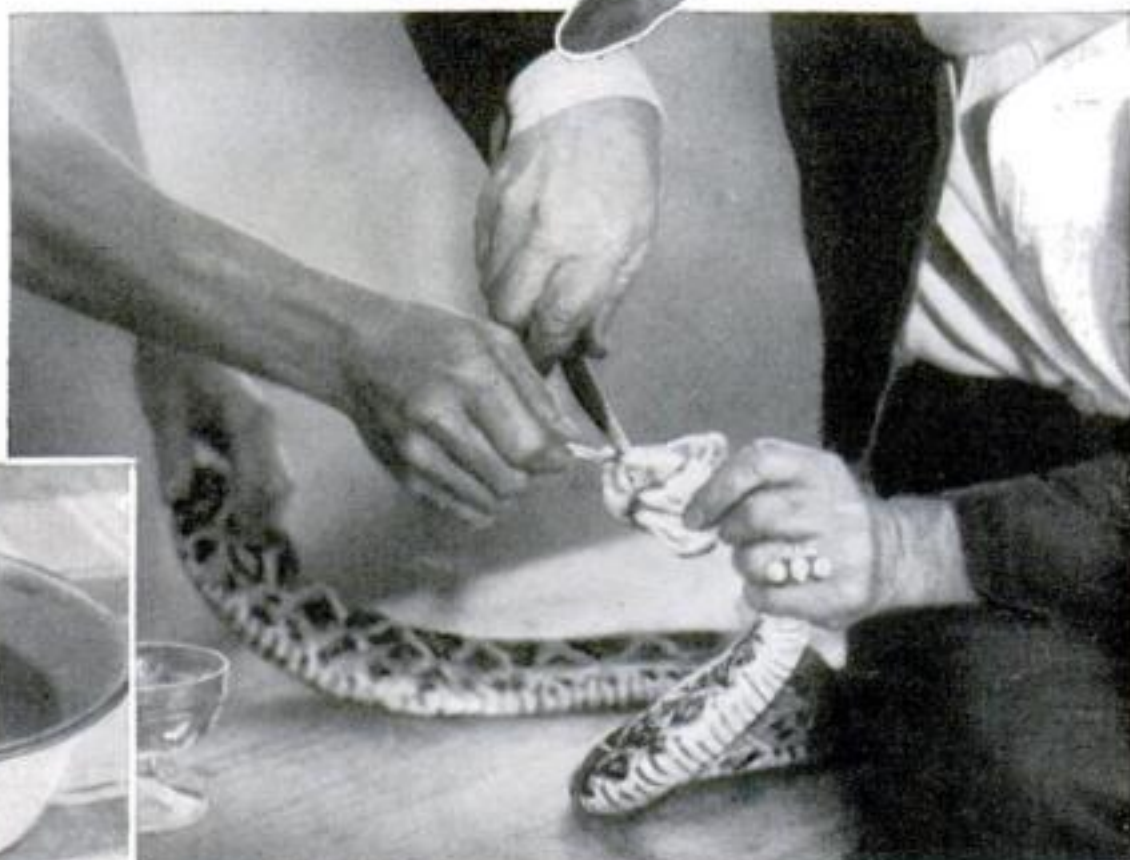


WITH carnival time returning to towns and cities, the oldest thrill show on earth, the performance of the snake charmer, is beginning another season. The pictures on these pages reveal the hair-raising job of "Texas Jim" Mitchell, a professional snake dentist who "fixes" the Florida rattlers used in these carnivals and medicine shows.

Each year, Mitchell removes the poisonous fangs from between 200 and 500 diamond-backs at his Sarasota, Fla., reptile farm. Before operating on each snake, he milks it of most of its venom by pressing its fangs over the rim of a glass, thus lessening the chances of a fatality if, through some slip, the serpent buries its fangs in his hand or arm. An emergency kit, holding a safety-razor blade and a shoe-string tourniquet,



Skull of a rattlesnake, showing the long, curved fangs that are extracted from live diamond-backs by "Texas Jim" Mitchell, seen at left with a patient



The snake fixer at work. Here he is cutting around the base of the fang so it will not break off when pulled. Emergency supplies at left include a razor blade, shoe-string tourniquet, and poison antidote

Pulls Rattlers' Teeth

stands ready for instant use. As a final step in preparation, he washes his hands and wrists in a wine-red solution of potassium permanganate. This chemical oxidizes venom and destroys its action, thus preventing stray poison from entering cuts or abrasions.

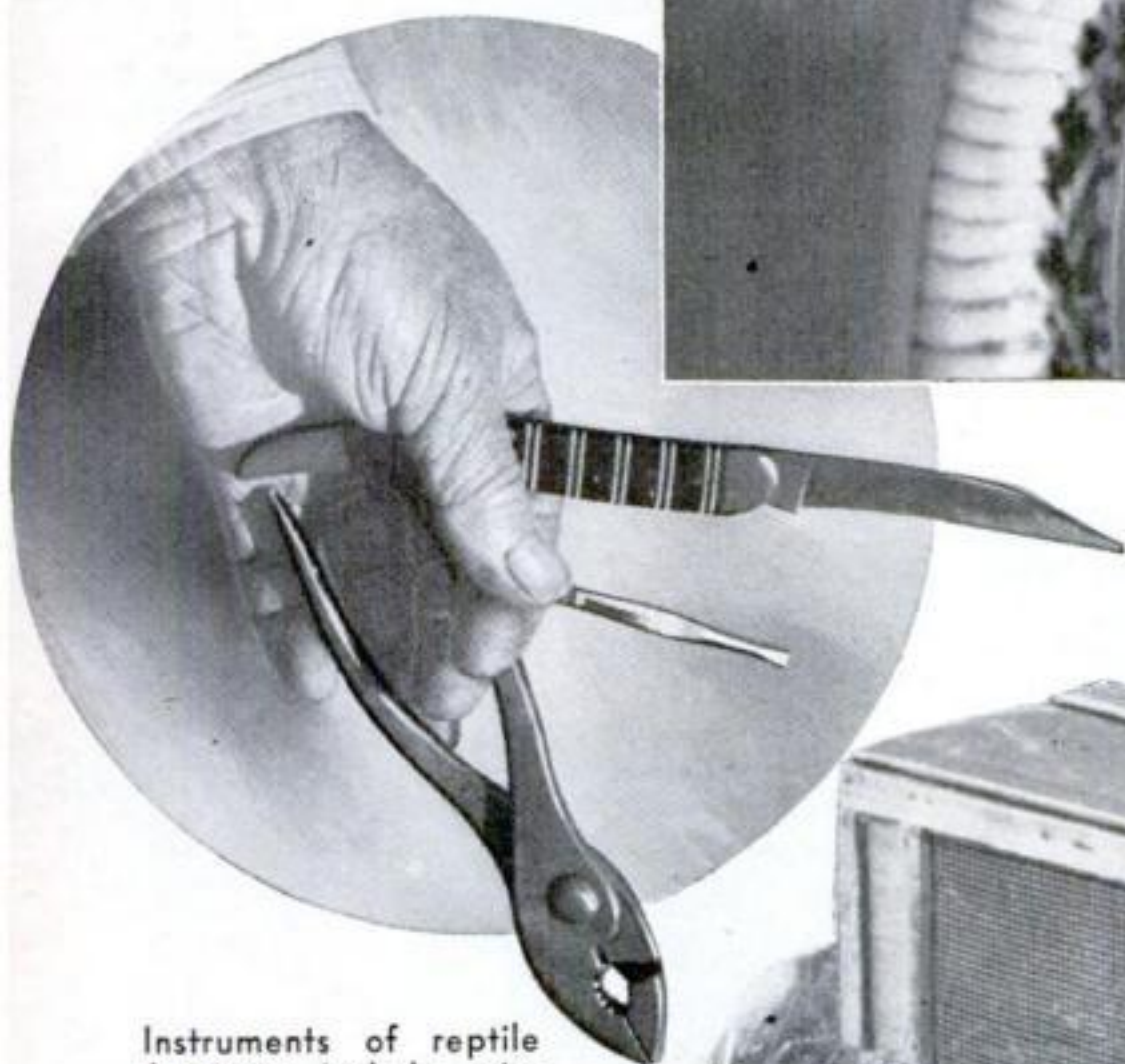
While an assistant grips the tail of the writhing diamond-back, Mitchell sets to work. Just behind the two main fangs, he reaches his tweezers into small pouches of skin and pulls out auxiliary teeth, which, under normal conditions, replace the fangs if they are broken off or lost. Next, with the tip of a knife blade, he cuts around the base of each main fang. This prevents the hollow teeth from breaking off as he

jerks them free with a pair of pincers. The final step in the operation is washing out the snake's mouth with antiseptic to prevent infection.

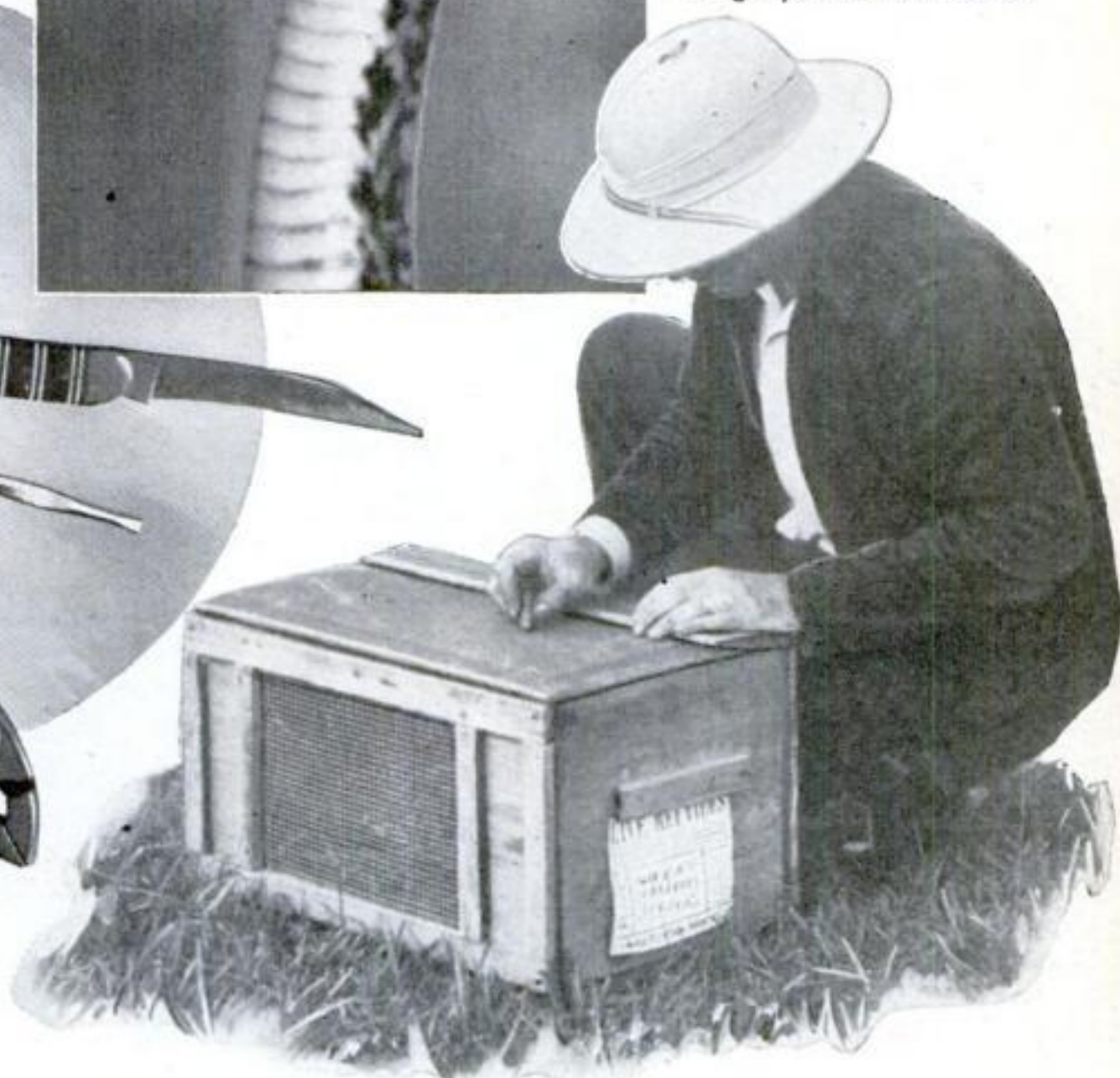
Mitchell sells his fixed rattlers in "dens." The smallest, fifteen-dollar den contains four medium-sized reptiles and one "giant snake," five or six feet long; the twenty-

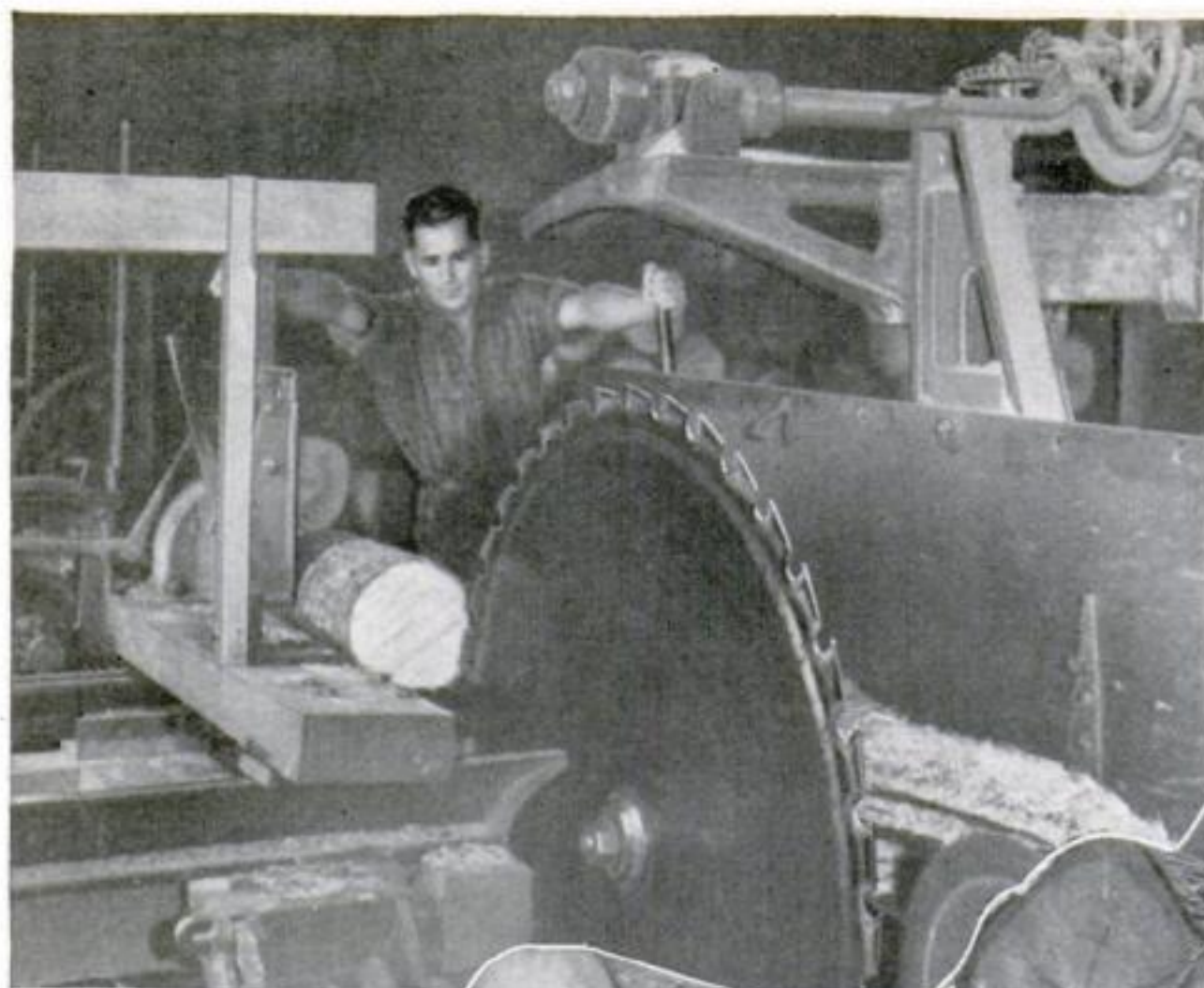
five-dollar den contains about eight snakes of assorted kinds and sizes, while Mitchell's largest collection, a \$100 den, consists of forty coiling, buzzing—but toothless—diamond-backs. The snakes are shipped in wood-and-wire cages, each box conspicuously labeled: "NONPOISONOUS RATTLESNAKE."

Open wider, please! Before starting to work, Mitchell first "milks" the snake to remove a large part of its venom



Instruments of reptile dentistry include pincers, tweezers, and a jackknife. At the right, the snake fixer marks a "den" of his disarmed rattlers for shipment





Alan Moteley at work in his own sawmill cutting up a log. Below, he is shown with his store of black walnut, the wood in which he specializes



City Lumberjack Buys Back-Yard Timber

WITHIN sight of the towers of New York City, Alan Moteley, of Point Lookout, on Long Island, makes his living as a lumberjack. Dealing mostly in black walnut, one of the most expensive of woods, Moteley tours the regions around New York City buying single trees from householders and owners of small farms and estates in the suburban areas. When he closes a deal for a tree, he cuts it down and hauls it to the sawmill he has set up at home, where the wood is sawed into boards and sold for making hardwood gun stocks, fine furniture, and other specialized items. Moteley himself uses part of his purchased black walnut to construct fine chests and other pieces of furniture in his own workshop. The success of this metropolitan lumberman is all the more remarkable because of the fact that an attack of infantile paralysis left him crippled before he started to earn his living at the age of fifteen.



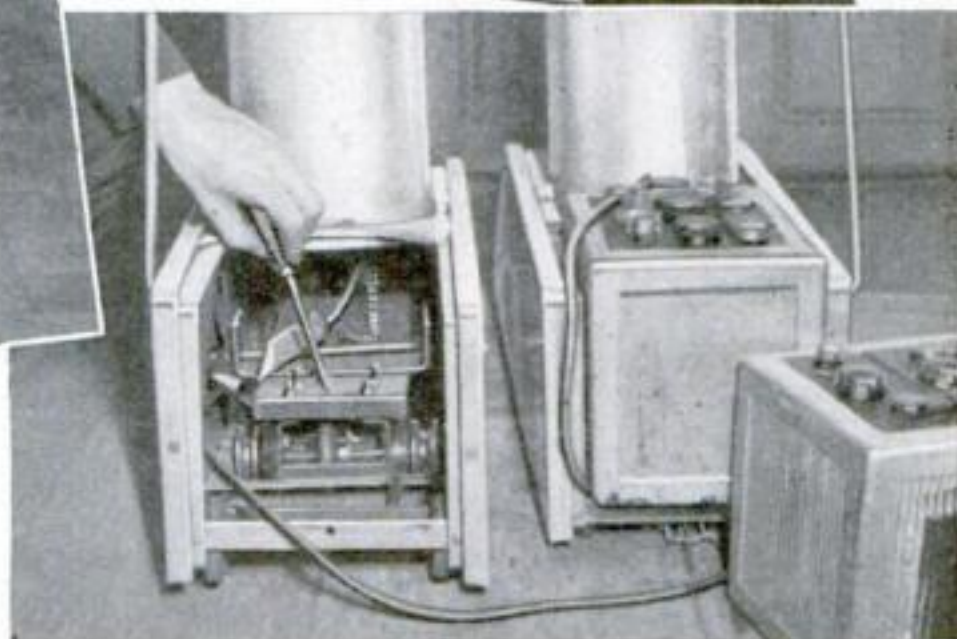
A typical fine-wood chest made by Moteley

Performing Robot Earns Money for Its Owner

RENTING the services of an electrically operated robot which he built is the curious business of Austin Huhn, of New York City. Clarence, as the mechanical man is dubbed, walks, talks, gestures with his arms, and performs other feats at banquets, meetings, and conventions. Nine feet tall, the 300-pound robot is powered by storage batteries installed in its feet, and remotely controlled by means of relays and radio which his master operates from the side lines. A loudspeaker installed in its chest is the robot's voice.



Austin Huhn at the radio panel from which he controls the movements of Clarence, seen at upper right. The aluminum robot is powered by storage batteries, right, in its feet



TRAINING AIR-DEFENSE

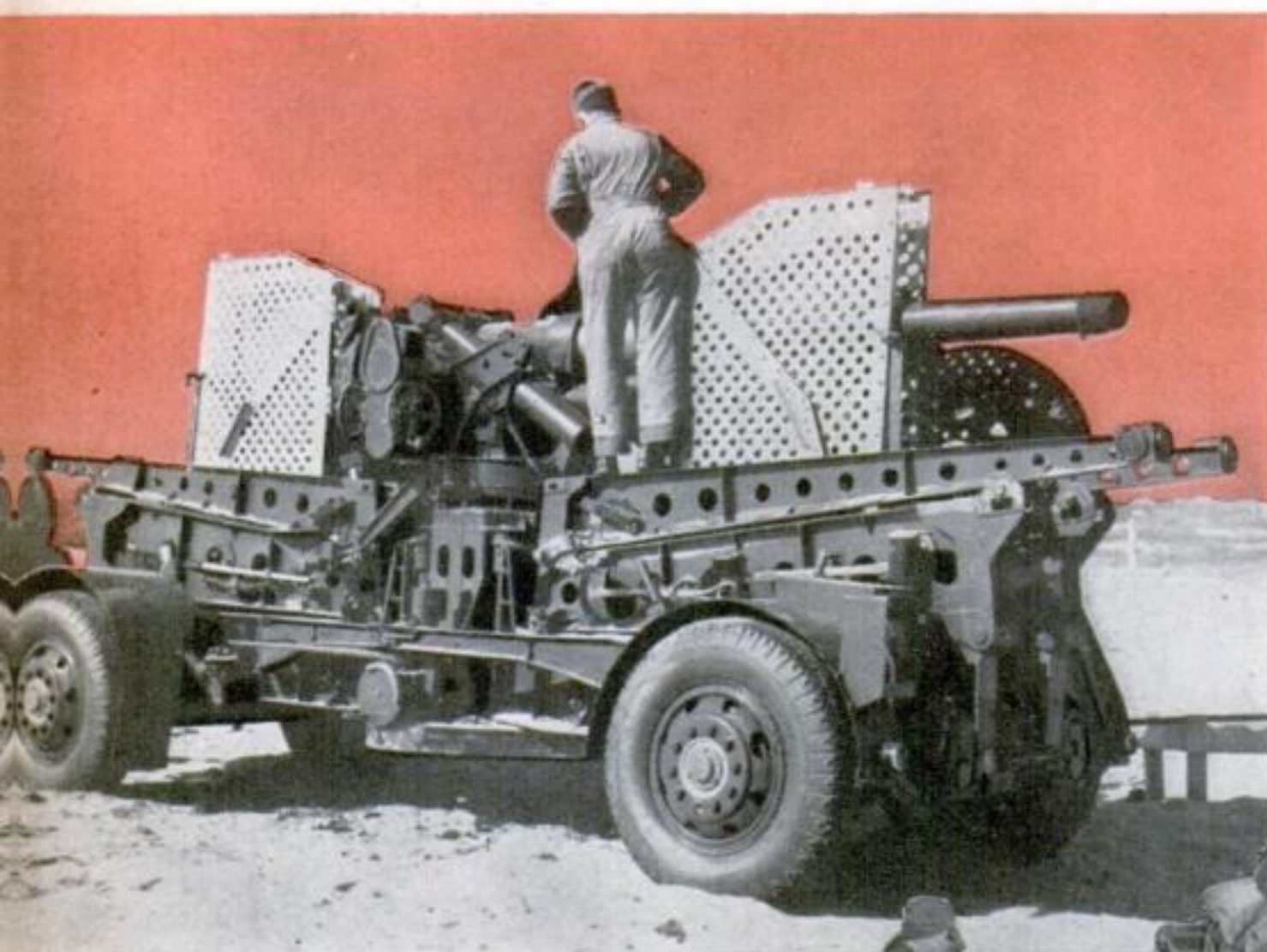
EXCLUSIVE

To give its readers a behind-the-scenes peek at Uncle Sam's aircraft defenses, Popular Science Monthly presents these exclusive photographs showing how gun crews are trained. These are the first pictures of this drill ever filmed for publication.

HIGH-SPEED bombing planes destroying bridges, gutting airports, and wrecking gun emplacements; low-flying birds of death strafing columns of advancing infantry; huge transport planes raining parachute troops down behind defensive lines—these current indications of the major rôle being played by airplanes in modern warfare make it of paramount importance for defending forces to train ground-based antiaircraft troops for combating this menace that comes from the skies.

How is Uncle Sam training his army to meet the challenge? To find out, follow the men of the 62nd Coast

One of the three-inch antiaircraft guns of the 62nd U. S. Coast Artillery arrives at the practice range on its mobile trailer. It is seen below in action with its crew





GUNNERS

An Army plane
tows the target

Artillery as their antiaircraft batteries roll into Ft. Tilden, N. Y., for a firing-practice session. Hauled by seven-ton trucks, three-inch guns capable of hurling twenty-five fifteen-pound shrapnel shells a minute thunder in at forty miles an hour, followed by truck-drawn trailers loaded with fire-control apparatus, electric generators, cables, ammunition, range finders, and the other paraphernalia of antiaircraft war.

Soon the field of fire throbs with action, as tractors maneuver the mobile six-ton guns into firing position, ammunition is unpacked and cleaned, range finders and automatic computers are installed and connected electrically with the guns and with each other. Officers equipped with stop watches get set to time the rate of fire. Meteorological apparatus is ballooned aloft to determine wind

Firing data are computed by the mechanical brain at the right, which is connected to the range finder below, and automatically sets the guns' aiming dials and fuse timers

speeds and directions at various altitudes. Medical Corps men supply cotton for gunners' ears.

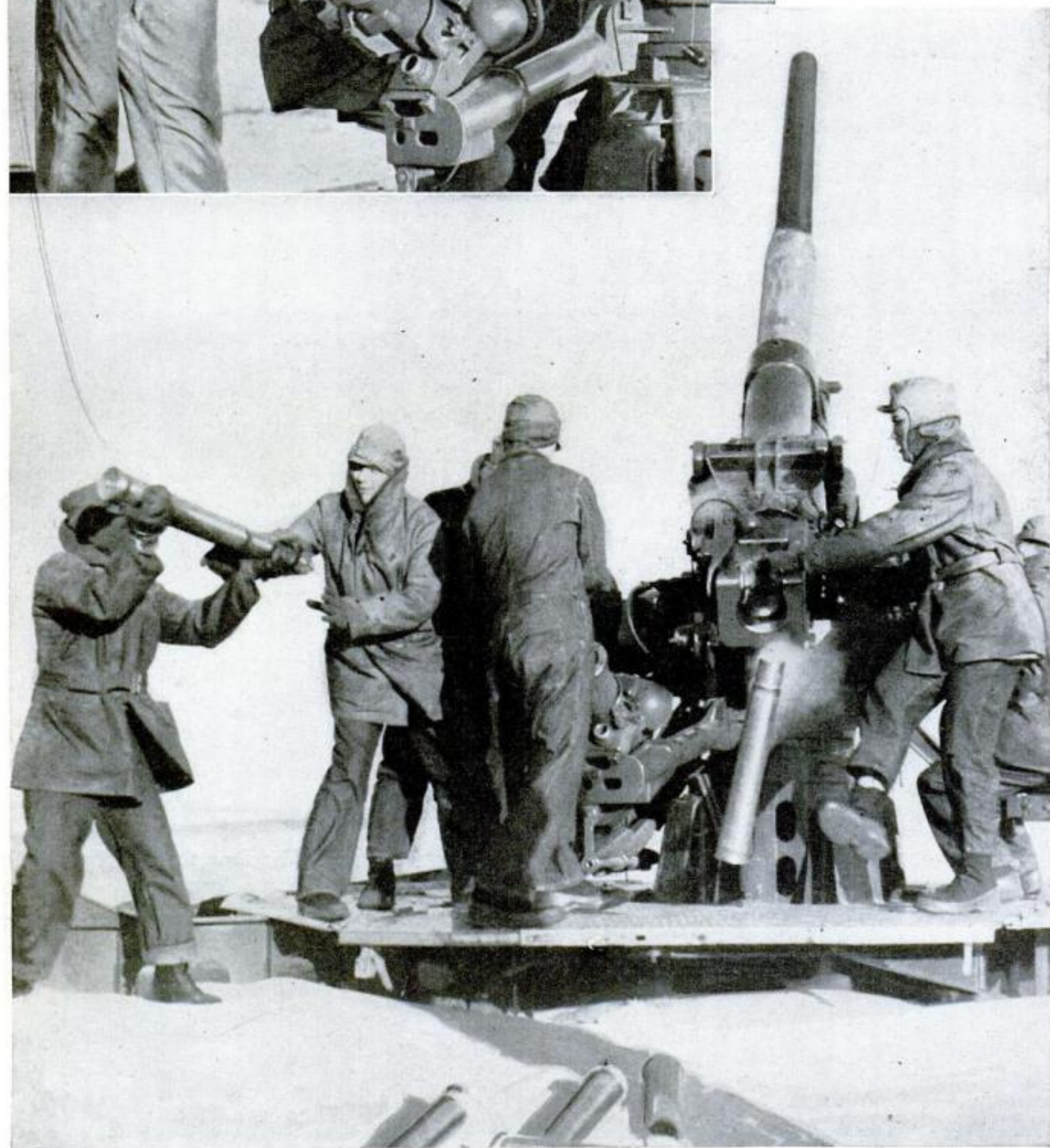
And because this is peacetime action, a safety officer and his staff prepare to forestall accidents. Previously they have cleared all shipping and small craft from the waters over which the guns will fire. Now they

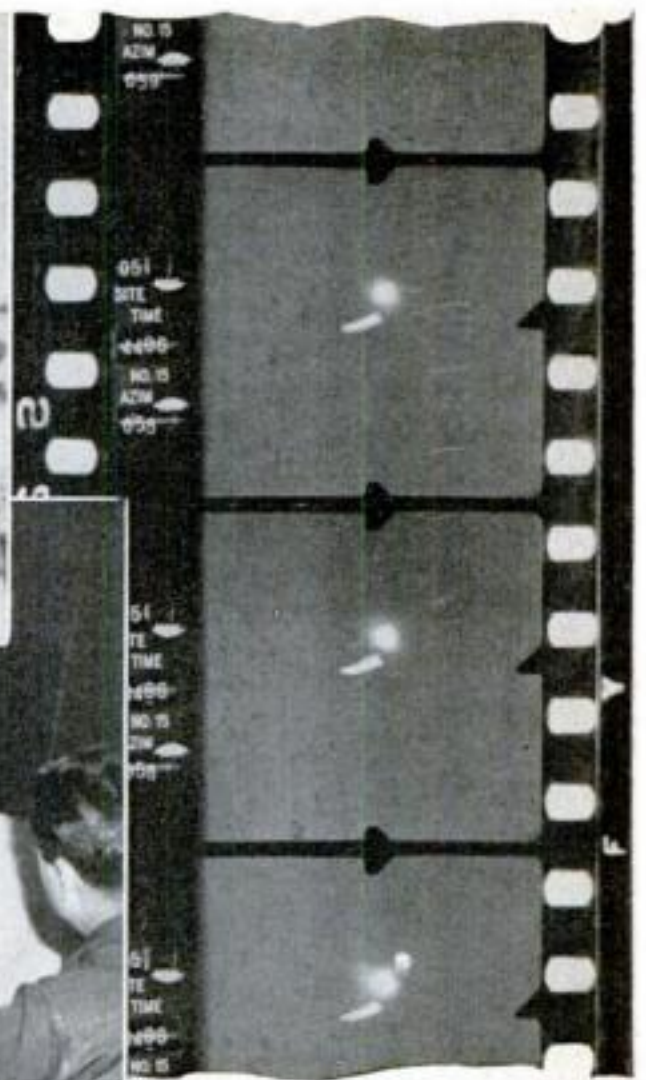
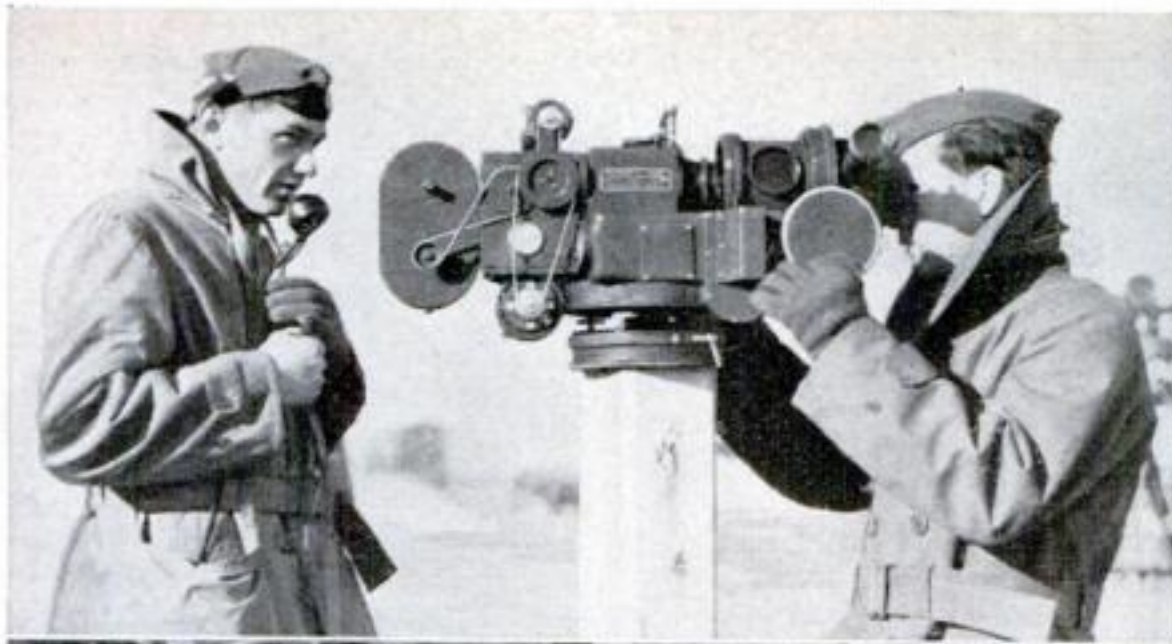




A member of the gun crew inserts a shell in the fuse timer. Here mechanical fingers, controlled by the computing system, set the fuse to go off at right time

Split-second timing, with the gun in full recoil. One man kicks away the ejected cartridge while others set the fuse of the next shell and pass along still another





COUNTING THE HITS

Theodolite movie cameras, like the one at the upper left, keep a film record of shell bursts around the target. Movies are projected later, left, for study

set up a telescope to observe the Army plane that will tow the thirty-foot "sock" target on a 3,000-foot cable. No firing will be allowed until the plane is at a safe angle away from gun range. When all is in readiness, a red signal flag, hoisted atop a tall tower, warns that firing is about to begin.

At the long horizontal range-finding instrument, trackers peer into telescopic sights to determine the horizontal and vertical position of the target in the air. At a central sight, an observer employs his highly trained gift of three-dimensional vision to enable the delicate instrument to figure the range and convert it into altitude.

Coördinating and correcting the altitude and position information furnished by the range finder is the job of the unit's mechanical brain, an amazing automatic calculator that computes firing data for the anti-aircraft guns, which are aimed solely by adjusting controls to agree with gun-mounted instrument dials electrically connected to the mechanical brain. The gunners never even look at their target, for often, at the moment of firing, the gun muzzle will point 1,000 yards ahead of the target.

Suddenly the air splits with a terrific din

as the guns blast away at the tiny white target in the sky. Soldiers trained to split-second timing pass up shells with the precision of an all-American backfield. Like clockwork, shells move from ammunition racks to fuse timers on the guns, where mechanical hands automatically set the fuses to burst the shrapnel shells at the exact altitude of the target, as figured by the range finder and passed along by the mechanical brain. Out of the fuse timer and into the gun breech, shells move at the rate of one every two seconds.

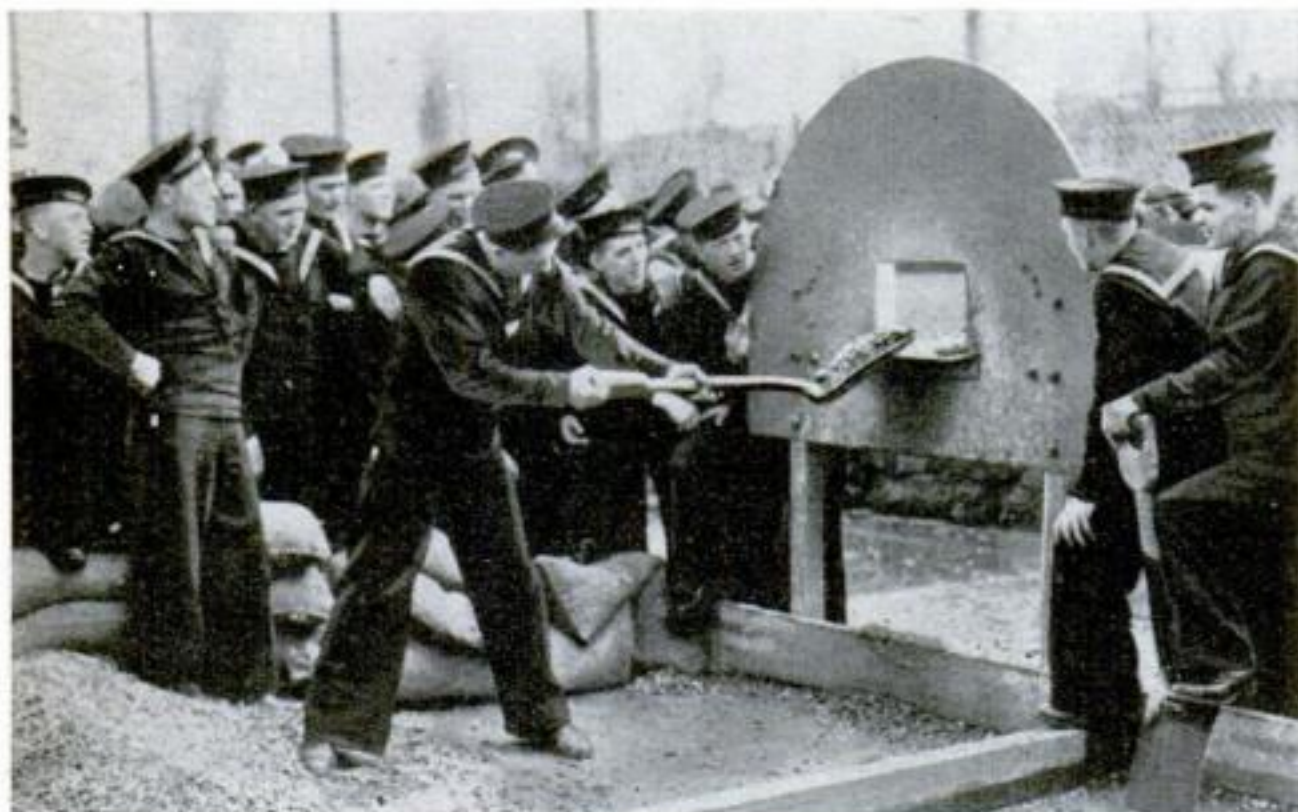
BUT how is the success of this antiaircraft practice determined? First, of course, by examination of the target, but more accurately by the use of two specially designed, synchronized motion-picture cameras. Operating from separated positions, these cameras are constantly trained on the target. On each frame of the film in each camera, figures indicating the exact time and the exact angular aim of the camera, are automatically recorded. Thus, when films are developed, individual frames can be matched to determine precisely where the shells burst in relation to the target.

Radio-Controlled Boat Tested as Torpedo



A model demonstrates a possible use of the crewless boat for blowing up enemy ships. Above, officers direct it from shore

BLOWING up enemy vessels with pilotless speedboats packed with deadly cargoes of high explosives is the possibility suggested by the recent development of a new radio-controlled craft. Invented by Henry W. Wickes, a lieutenant in the U. S. Naval Reserve, a model of the proposed boat was tested recently in waters off New York City. Six feet long, with an eighteen-inch beam, the model is powered by a six-volt storage battery and remotely controlled by means of a high-frequency radio transmitter with an effective range of eleven miles. On a fully charged battery, the model craft is said to run for fifteen miles.



Beach pebbles double for coal in this dummy set-up for stoking practice

Dummy Boiler Helps Train Navy Stokers

INSTRUCTION in the most efficient shovel swing for stoking the fires of a warship is aided by the dummy furnace door pictured in use by British tars in the photograph at the left. Beach pebbles take the place of coal during the practice sessions. The men are fishermen enlisted for naval service.

New "Big Bertha" Poised Behind German West Wall

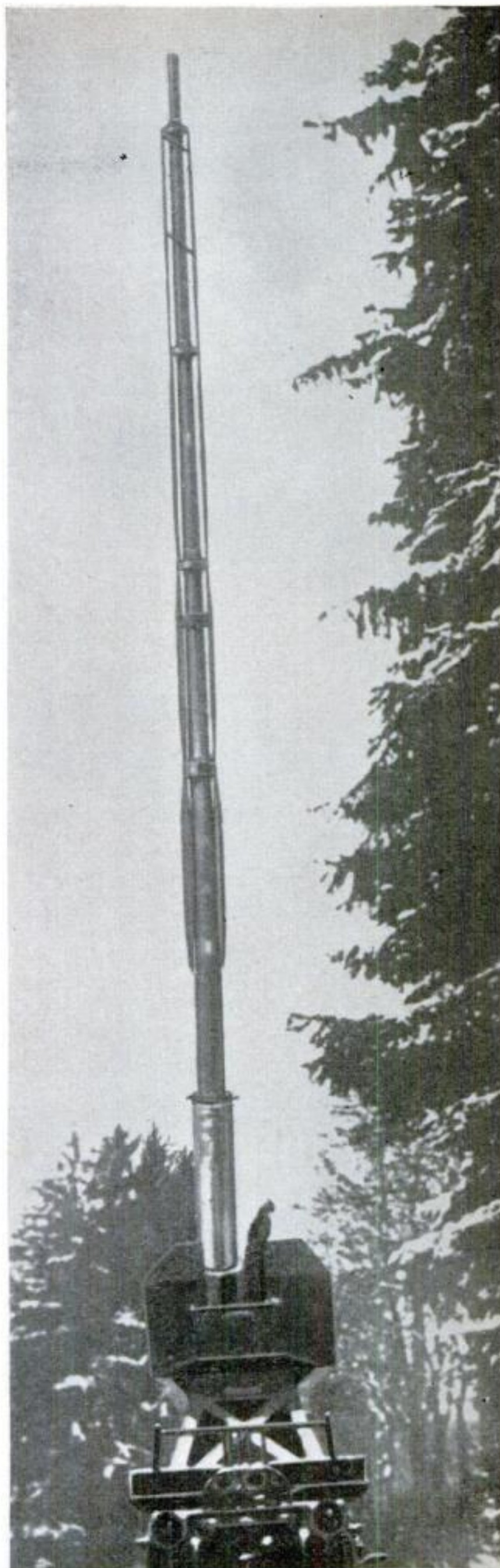
TOWERING high into the air, the mammoth German gun pictured at the right has a barrel more than seventy feet long. Installed in a forest emplacement somewhere behind the Siegfried Line of fortifications on the Western Front, Germany's latest "Big Bertha" is designed to hurl shells for tremendous distances, although its exact range is a military secret that has not been revealed. It is expected, however, that the gun's range is greater than that of the long-distance cannon used by the Germans in the first World War to drop shells into the city of Paris from over seventy miles away.

Bottles Serve As Bombs for Use Against Tanks

POP BOTTLES filled with inflammable liquids and fitted with automatic igniters have been adopted by European armies as a defensive weapon for combating enemy tank attacks. Designed to be used in conjunction with explosive hand grenades, the bottles burst into flame on smashing into a solid object. In the photograph reproduced below, one of the fire grenades is shown just after it struck a steel plate and burst into flames.



Designed as an anti-tank bomb, the bottle spreads flaming chemicals when it breaks



Compare the size of the man with the towering gun

"Machine-Gun Skeet"

CLAY targets, streaking in front of mobile machine-gun turrets at an English flying base, are now being used to perfect the marksmanship of Royal Air Force gunners. In the first World War, most airplane machine guns, particularly those on pursuit ships, were fixed in place and were aimed by pointing the plane at the target. Today, in the latest multimotored bombers, electrically



A machine gunner about to start practice in a wheeled gun turret like those mounted in the noses and tails of bombers above and below

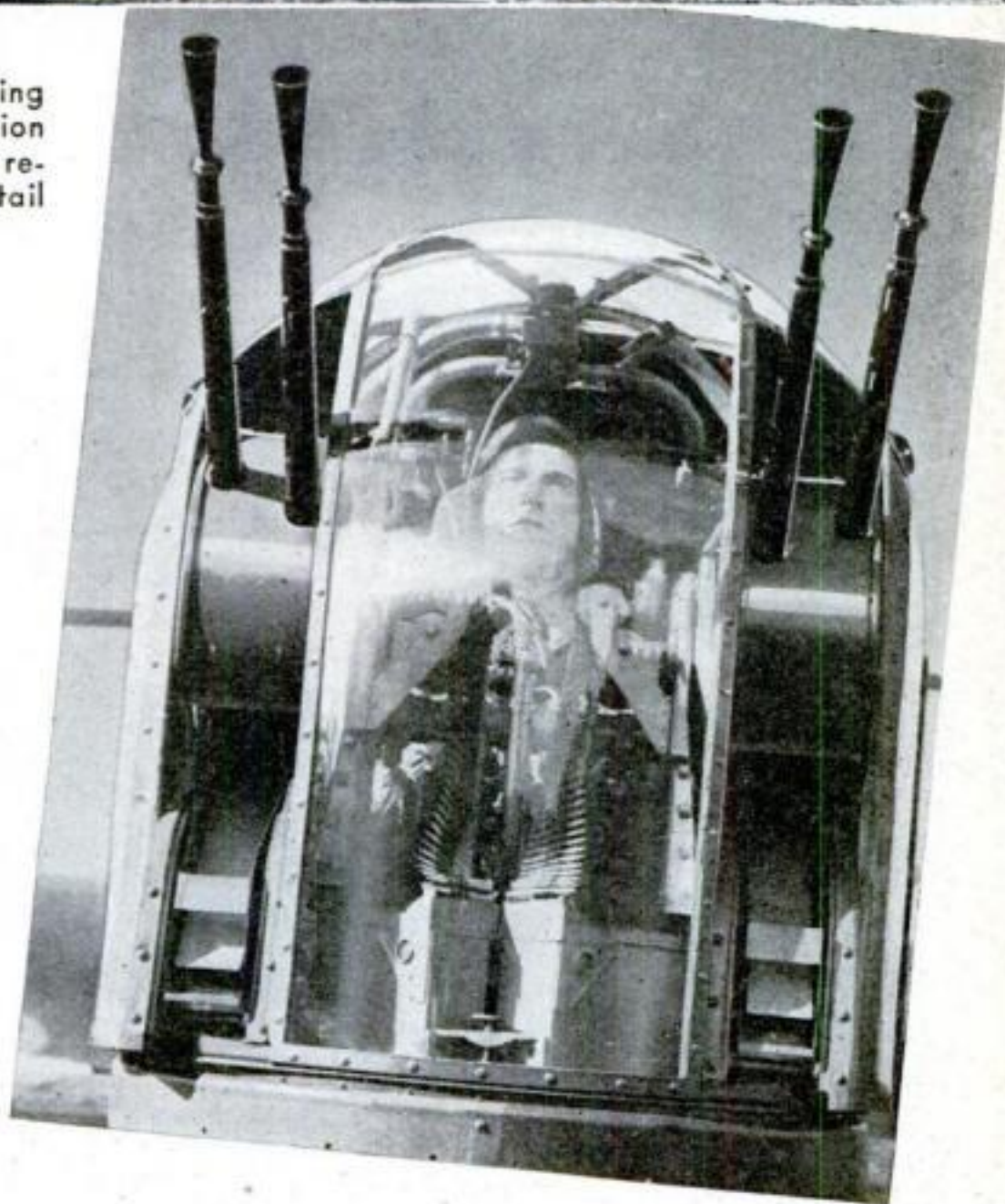


Makes Flying Marksmen



Gunnery practice consists of shooting clay pigeons hurled by the regulation trap in foreground. Great skill is required. Below, guns in bomber's tail

operated turrets, one at the tail and one at the nose, house as many as four movable machine guns and an expert marksman to aim them. Some bombing craft even have a third machine-gun "blister" at the center of the fuselage as an added protection against attacking planes. Merely by pressing buttons, the gunner can swing his turret in any direction he desires. To train experts to man these vital posts, British officers are mounting spare turrets on rubber-tired dollies so they can be wheeled to isolated areas for gunnery practice. Just as in skeet or trap shooting, clay disks are sent skimming through the air as gunners attempt to shatter them before they fall to the ground.



Simple Exercises Bring



DO YOU have trouble getting to sleep at night? If your insomnia is not caused by some physical ailment or illness, simple exercises that anyone can do will solve your problem, according to Miss Josephine Rathborne, who conducts a course in the subject of relaxation and restful slumber at Teachers College, Columbia University, New York City. The trouble with most persons who are unable to drift off into dreamland easily, Miss Rathborne states, comes from an inability to relax their muscles from the strained positions they get into during the day. Because of the nature of their work, for example, typists experience abnormal tension in their wrist muscles, dentists in their backs, and desk workers and students in the muscles at the back of the neck. Although the Columbia sleep course makes no attempt to invade the province of a physician in curing insomnia caused by physical ailments, the exercises pictured on these pages, it is said, will aid anyone to eliminate tension, and thus induce slumber.



Crawling is a good way to woo slumber, as it releases muscular strain all over the body. Move the right arm and right leg at the same time



Swinging the arms, letting the weight hang naturally, relaxes the tension of the day's work

A rolled-up towel makes a handy rest.

for relieving tired feet and legs

Y O U

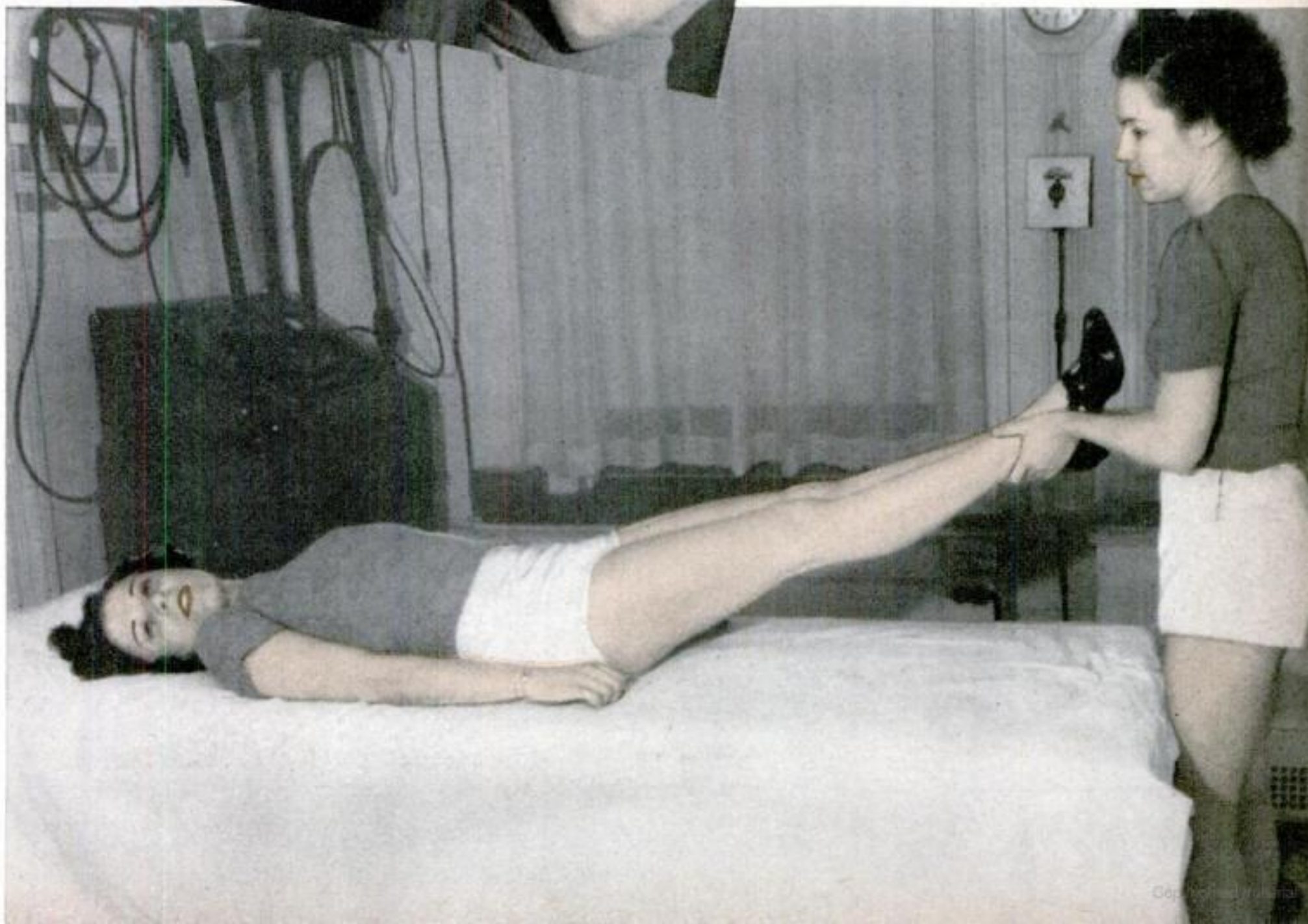
Restful Sleep

The easy test below shows when relaxation is gained. The subject's arm is swung sidewise several times at the elbow, while the hand is held steady. If the arm and hand drop immediately when released, the muscles are now completely relaxed

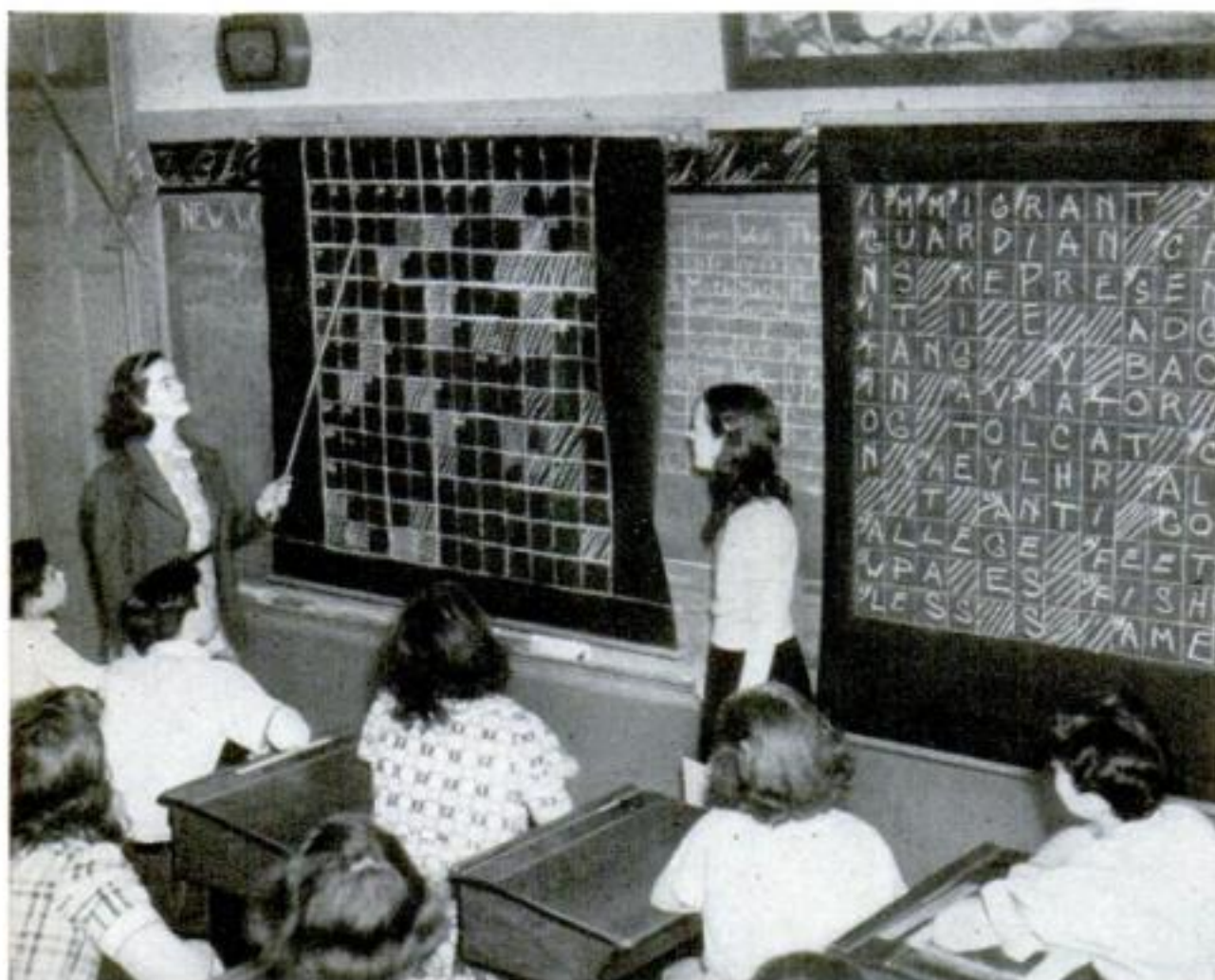


To rest the muscles of the neck, place the towel roll under the neck and let the base of the skull lie on its edge

Swinging the legs in a circular motion from the hips, as demonstrated below, helps relax the muscles of the thighs



Cross-Word Puzzles Help Teach English

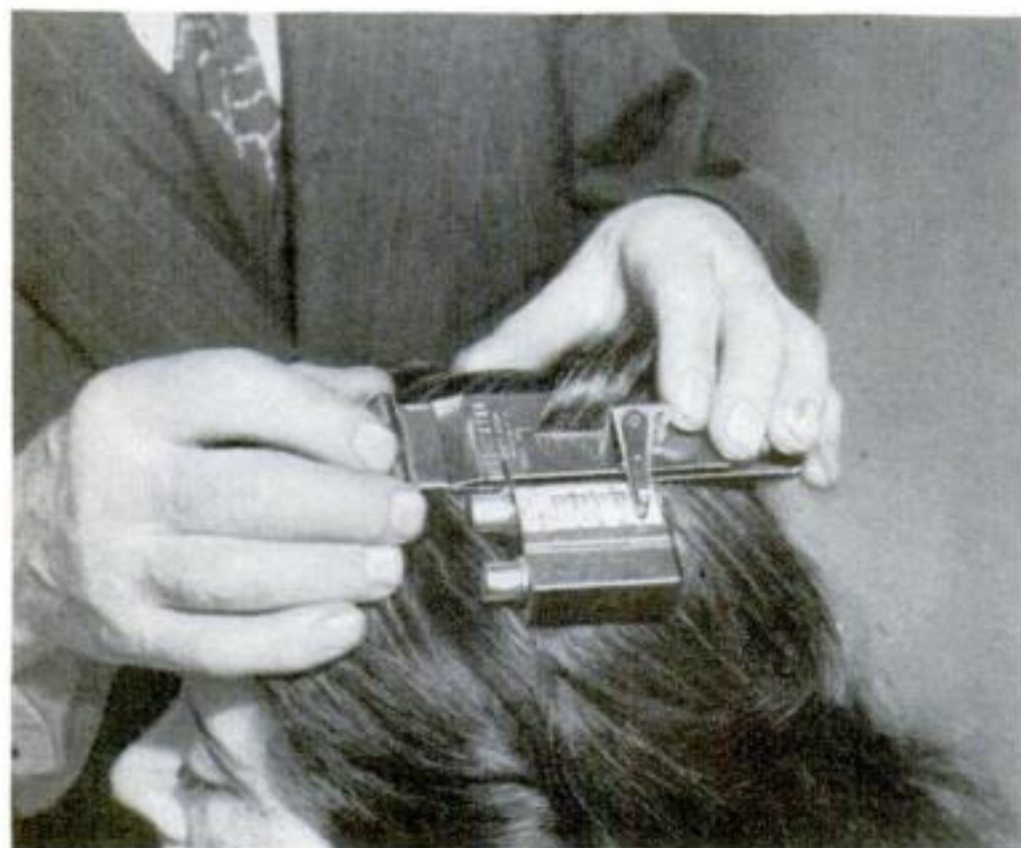


CROSS-WORD puzzles form an unusual part of the curriculum for eighth-grade pupils at the Martin School in Roxbury, Mass. The puzzles, said to be helpful in enlarging vocabulary and teaching spelling and grammar, are made up by individual students, and then laid out on the blackboard for classmates to solve. When thirty good puzzles have been concocted, the students reproduce them in small puzzle-book form with the aid of a mimeograph machine. The puzzle books are then sold for ten cents each, the profits going into the school fund.

Eighth-grade students solving a puzzle made up by a member of the class

Is Your Hair Getting Thin? This Gauge Will Tell You

How rapidly hair is thinning out, a factor that may warn of impending baldness, is determined by a novel hair gauge. When the hair growing over a measured area of the scalp is placed in a slot in the device, a sliding metal arm marks a movable tape to indicate hair density. By testing the same area of hair at a later date, the rate at which hair is thinning out can easily be determined, and preventive measures can be taken if necessary.



Measuring thickness of hair. A record is made on a tape



Guard Holds Fingers To Dry Nail Polish

WHEN liquid polish is applied to finger nails during a manicure, a novel guard keeps the fingers apart to prevent smudging the polish or staining the fingers while the polish is drying. Illustrated below, the guard is held in place by the slight pressure of the flexible material of which it is made.



The saw rolled up, with handles and carrying case. Drawing at left shows it in use

Crosscut Saw Goes in a Pocket

FOR woodsmen, campers, and explorers, a portable two-man crosscut saw now available can be collapsed into a compact form small enough to be carried in a coat pocket. Made of tempered steel, the saw is jointed at frequent intervals along its length like a block chain, making it possible to roll the

tool up into a shape roughly circular and measuring about four inches in diameter. In use, hardwood handles are inserted in holes provided at the ends of the saw. A canvas carrying case which holds both the saw and the handles for transportation is provided with the unit.



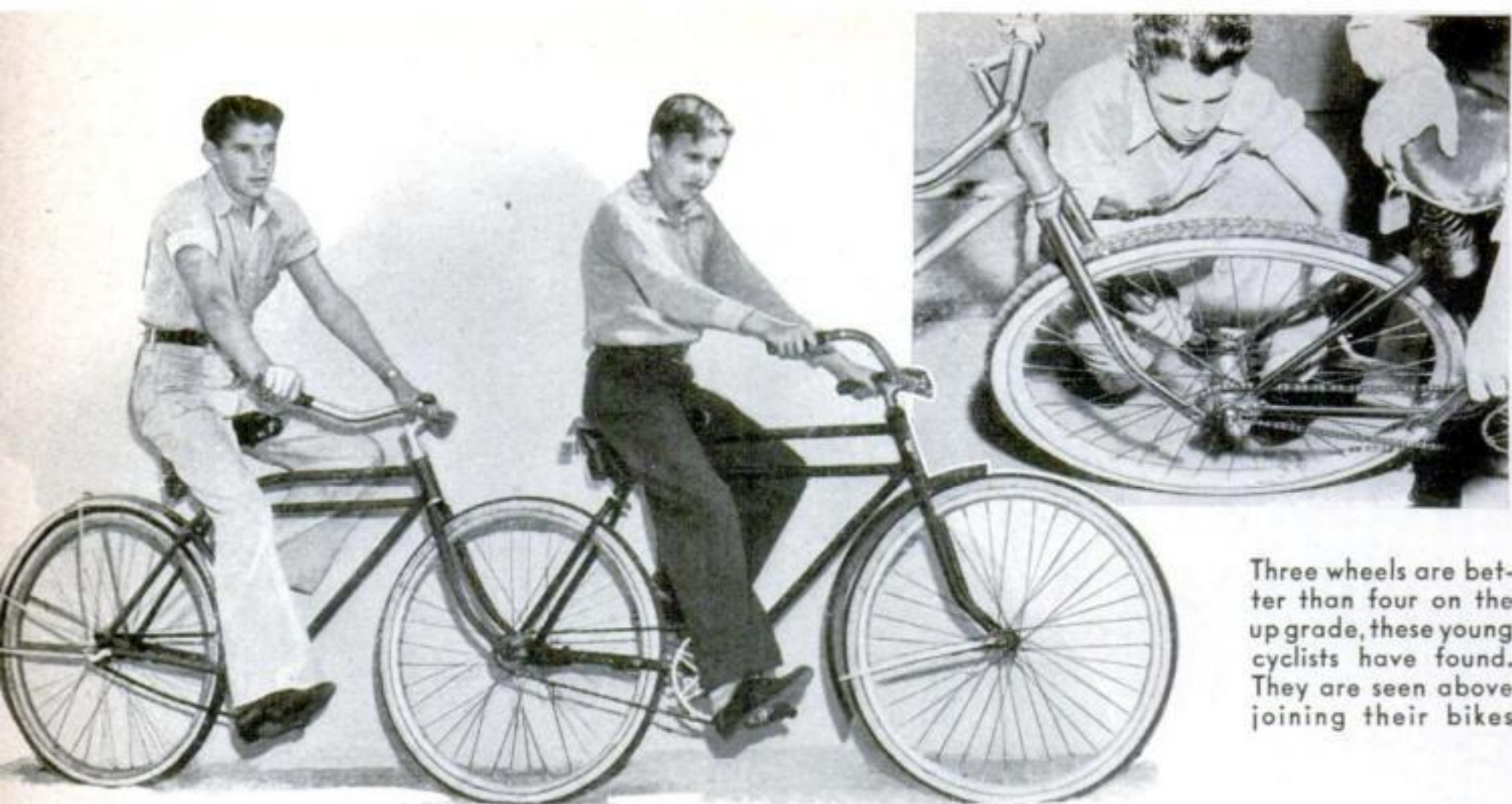
Electric Stove Is Portable

FOLDING legs on a new electric stove for travelers, or campers who have access to electric power, make it easy to pack into a suitcase or knapsack. Equipped with a thermostatic heat control, the stove measures only an inch and a half in depth when its wire legs are tucked out of the way.

Fishhooks of New Alloy Can Never Get Rusty

FISHHOOKS made of a new metal alloy that is said to be completely rustproof are now available to anglers. The hooks, made of an alloy containing about ninety-eight percent nickel, are expected to prove a boon especially to deep-sea fishermen, since salt-water corrosion of unprotected hooks can dull the points and weaken the barbs. Since the hooks are not merely plated with the alloy, but made of solid metal, rustproof protection will last for the life of the hook, according to the manufacturer. At the present time, the nickel-alloy hooks are manufactured in five O'Shaughnessy-style sizes for fish ranging in size from giant tuna to small-mouthed flounder.



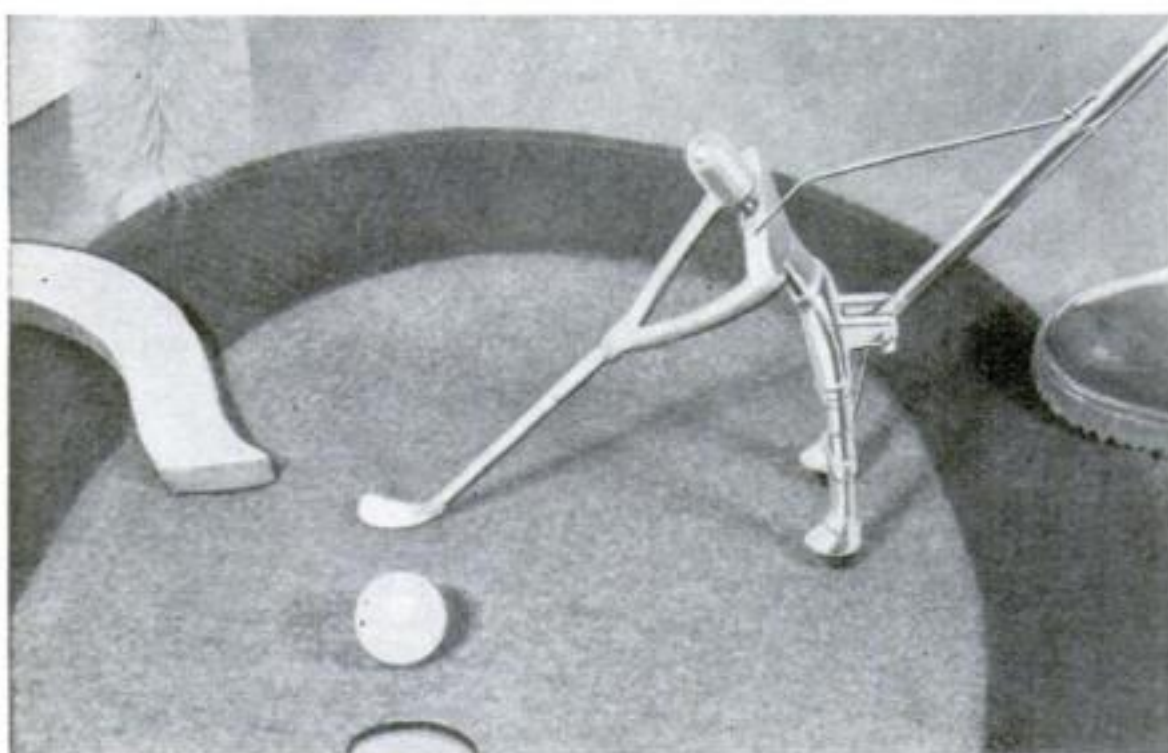


Three wheels are better than four on the upgrade, these young cyclists have found. They are seen above joining their bikes

Siamese-Twin Bicycles Take Hills Easily

Two bicycles become a bicycle for two when the pedaling gets too tough for the Hollywood, Calif., boys above. When steep hills are encountered on their cycling trips, they simply remove the front wheel from one of the bikes and bolt the empty fork to the

rear axle of the other. With the extra wheel slung over the handlebars, they can pedal their way in tandem with just about half the effort required if they do it separately. It takes about five minutes' work with a wrench to make the change.



The little fellow at the left does the putting on tiny greens in this living-room golf game

Golf Game Uses Midget Player

IN A new indoor golf game, a full-size ball is putted on a miniature green by a midget mechanical golfer mounted on the end of a clublike handle. Downward pressure on the upper end of the handle causes the tiny figure to swing realistically and, according to the manufacturers, it is entirely possible to obtain a slice, a hook, and even a back spin. Hazards are provided with the outfit.



Golf-Ball Retriever Wears Screen Guard

PROTECTED from whizzing golf balls by a wire screen strapped to his back, the driving-range ball retriever pictured at the right uses a mechanical hand to pick up balls from the ground. When the hollow metal pick-up device is filled to its capacity of a dozen balls, it is emptied into a bucket carried by the other hand.



This driving-range attendant uses a mechanical hand to pick up balls



The portable boat rides a running board. Above, it is seen in the water

Sportsmen Get Light, Compact Folding Kayak

A LIGHTWEIGHT, portable kayak now being sold to sportsmen collapses into a flat, compact unit, six inches thick and twelve wide, that fits easily along the running board or on top of an automobile. Ten feet long, the sturdy craft tips the scales at forty-four pounds, can be set up or collapsed in two minutes, and is said to support 350 pounds in calm water. The craft may be propelled by paddles, a sail, or an out-board motor. Other sizes are also available.



One ball is for practicing smash shots, the other for drives

New Practice Unit for Tennis Players

WITH a novel practice apparatus just introduced, tennis players are able to develop and perfect their strokes without having to concentrate on getting up to a bounding ball and returning it across the net. The practitioner consists of two tennis balls held by means of elastic rubber cords supported by a bracket that can be attached to the wall of a building or to an upright of a tennis-court backstop. The balls can be adjusted to any desired position, making it easy to practice ground strokes as well as serves and smashes.

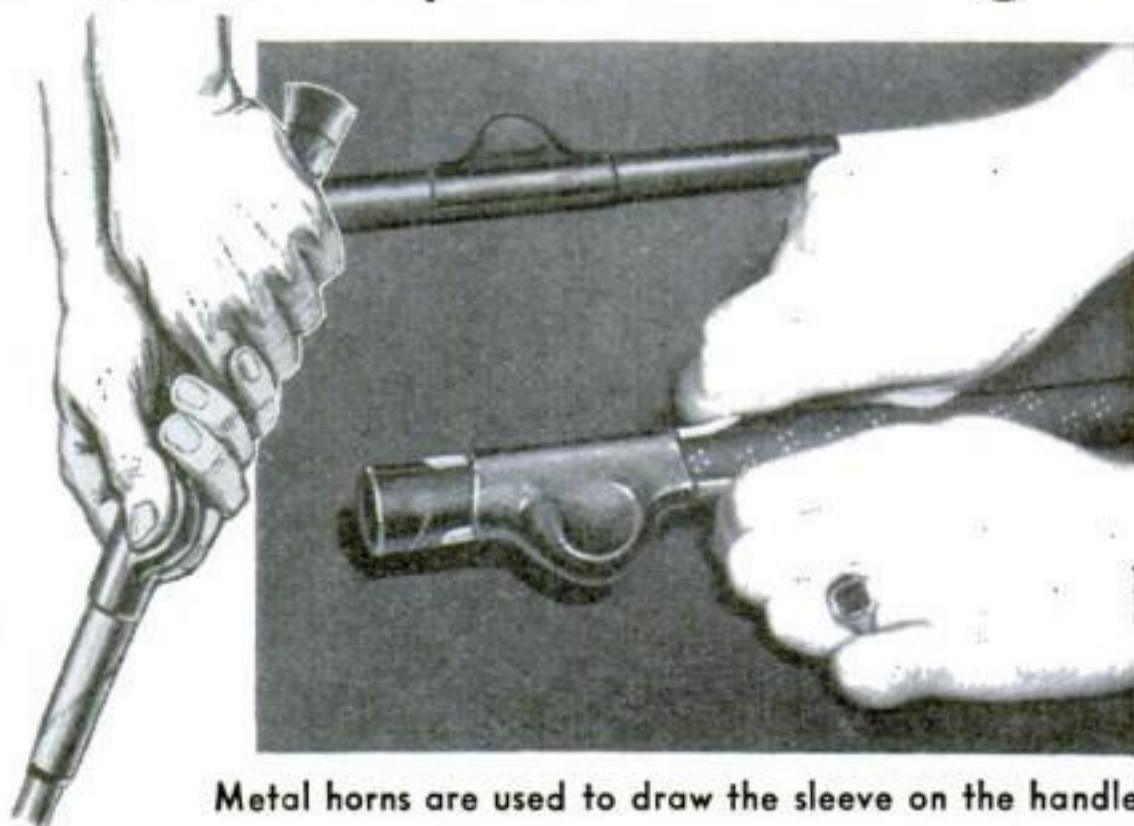
Spring-Operated Fishing Gaff

OPERATED by a powerful coil spring, the trigger-type gaff pictured at the right makes it easy for anglers to bring in any hooked fish up to sixty pounds in weight. The aluminum-alloy gaff automatically locks against the lower end of the grapple after striking the fish, holding it securely.



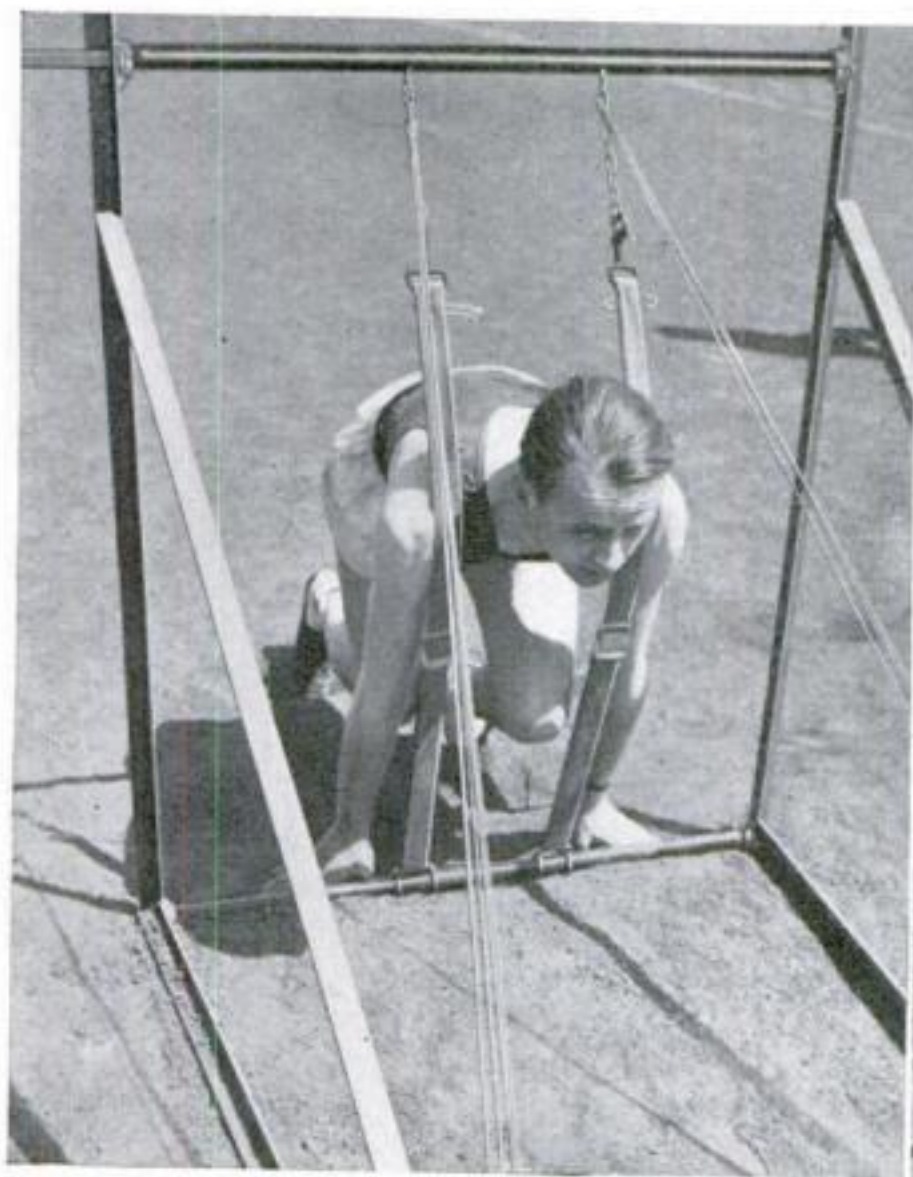
Grip for Golf Club Improves Putting

TO IMPROVE putting strokes, an Ohio manufacturer has brought out a novel golf-club grip in the form of a rubber sleeve with a special knob. The grip, shown in the drawing and photograph at the right, is designed to place the thumb and index finger in a relaxed, natural position, and so prevent any tendency to squeeze the club with those fingers. A smooth, steady stroke is said to result. Two metal horns are supplied to make it easy to slide the grip down over the putter shaft. It is then a simple matter to adjust the grip for use.



Metal horns are used to draw the sleeve on the handle

Gate Gives Runners a Fast, Even Start



A runner leans against straps which drop, as at right, for the start

BEATING the gun at the start of a foot race is an impossibility when runners start from a novel gate invented by Ben Ogden, track coach at Temple University, in Philadelphia, Pa. Taking the "get set" position, the runner leans against vertical straps held over the starting line by the metal gate framework. When the starting gun is fired, the straps are automatically released and drop to the ground, allowing the runner to lunge forward into a fast but fair start for the race.



New Boat Trailer Is Easily Loaded with Handy Winch

ONE MAN can easily take a small boat out of the water and load it onto a new type of two-wheel trailer designed for hauling water craft by automobile. The trailer is backed to the water's edge and a cable attached to a ring at the boat's prow. With one end of the trailer tongue under the boat bow, pressure on the other end raises the bow out of the water, while turning the cable winch at the forward end of the trailer hauls the craft up over rollers and into place. The keel of the boat rests on the entire length of the trailer's channel-steel tongue. Two models of the trailer are available, one twelve and the other fourteen feet in length.

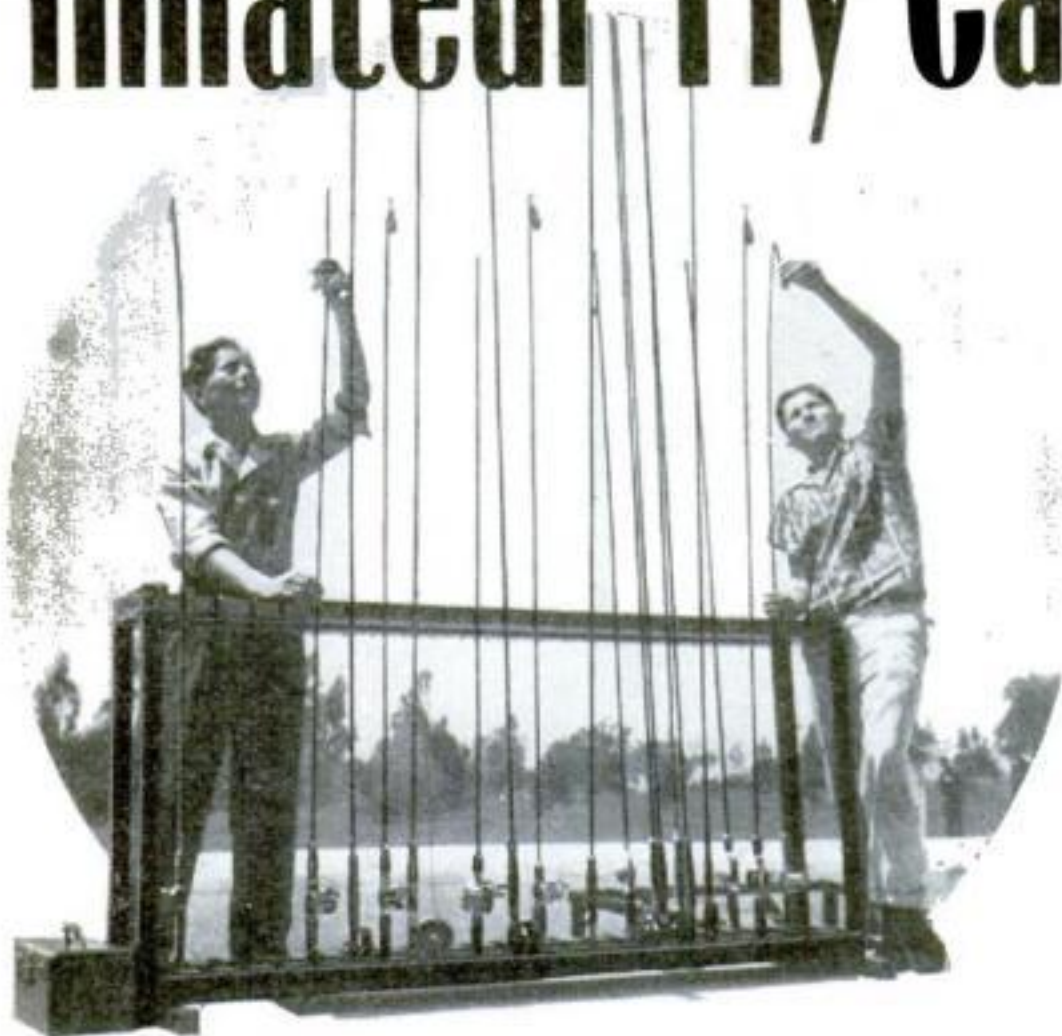


With the trailer tongue for a lever, the boat's bow is lifted from the water. Then the craft is pulled into place with a cable winch

Amateur Fly Casters Build

TWICE a month, visitors to a recreation park in Long Beach, Calif., see an unusual spectacle. Standing on the edge of a circular, concrete-lined pool, men and boys are whipping fishing rods through the air, casting plugs and flies at painted hoops that float on the water. On the broad lawns surrounding the pool, scores of others are throwing their lines into imaginary waters, trying for greater distance and accuracy.

Members of the Long Beach Fly and Bait Casting Club, these enthusiastic amateurs start their sport by building part of their own equipment. In garages and home workshops, any evening, you can



Members of the Long Beach, Calif., Fly and Bait Casting Club practicing for a contest at a pool in a city recreation park. Above, two youngsters select their rods before entering a plug-casting event

Their Own Equipment

find them tying flies, building reels, making rods, or perhaps even braiding fine silk fly lines.

Not long ago, I watched Claude M. Kreider, an assistant fire chief, adjust a home-made form and run the razor-sharp edge of a plane down a three-sided bamboo strip. Satisfied with his handiwork, he soon was busy adjusting the click on a double-ball-bearing duralumin fly-rod reel, which he had finished that morning on the lathe in his garage. Now he joined a rod, fastened his reel, threaded a line through the guides, attached a beautiful fly which he also had tied, and stepped onto his rear lawn to practice casting.

When he finished whipping his line at an imaginary stream, Kreider brought his reel over for me to examine. "Double ball bear-

ings," he explained, "are set in ball races. This arrangement gives the reel long wear, which means it won't let me down in a tournament."

The big trick in fly reels, as anglers know, comes in adjusting an even click to feed the line at just the right tension. Kreider got the materials for his click mechanism from an old glass-hard emery-wheel dresser. As for his rods, this amateur builder read a treatise on rod making and proceeded to turn out a finished 9½-foot rod weighing five and three quarters ounces. Although he had never seen one built, from the first he found he could produce these willowy devices with ease. He has built fifty rods and a dozen reels within the last five years,

By JOHN E. LODGE



Claude M. Kreider, at right, tests a bamboo strip for a rod. Below, planing out a section. Left, his homemade reel

Contestants and gallery line the edge of the pool in the picture below. Don Walters, at right, admires a medal he won after six months of training in casting



Dick Miller, an outstanding distance fly caster, in action. A friendly rival helps him by handling line. Miller has formed a similar club at Huntington Beach



some for himself and some for friends.

"Come down to the clubhouse Sunday," he urged, "and we'll give you a treat." A few days later I visited the pool, and before the middle of the morning a crowd of several hundred were watching sixty casters, some unskilled beginners, others famous champions, dinging at the hoops.

At one of these meets, you'd find upward of 100 men and boys whipping fine fly rods and larger salmon rods on the lawn surrounding the clubhouse and trying their skill at the pool. Alternate meetings include juvenile events in which the youngsters are encouraged to beat their dads.

Sons of veteran casters commence their careers at tender ages. Young Pete Kreider packed into the high Sierras astride a sure-footed trail horse when only three, and caught trout at the head of the Kings River on flies, while straddling his father's shoulders. Peter, now thirteen, is one of the thirty-four juvenile members of the club who pit their skill against each other, casting five-eighths-ounce plugs into the painted hoops.

Peter finished fourth in an accuracy event that Sunday. Don Walters, fourteen, took top honors. "He was in back a month ago, and now he pops up and scares everybody," I was informed. Don grinned. "Yeah . . . and what does that make me, junior champion, or something?" When a gleaming yellow badge was pinned on Don's sweater, he grinned again. "I've had some ribbons," he said proudly, "but this is my first gold medal."

Farm Wife Makes Paintings on Cobwebs

A cobweb for a canvas is captured on a cardboard frame, as shown at right



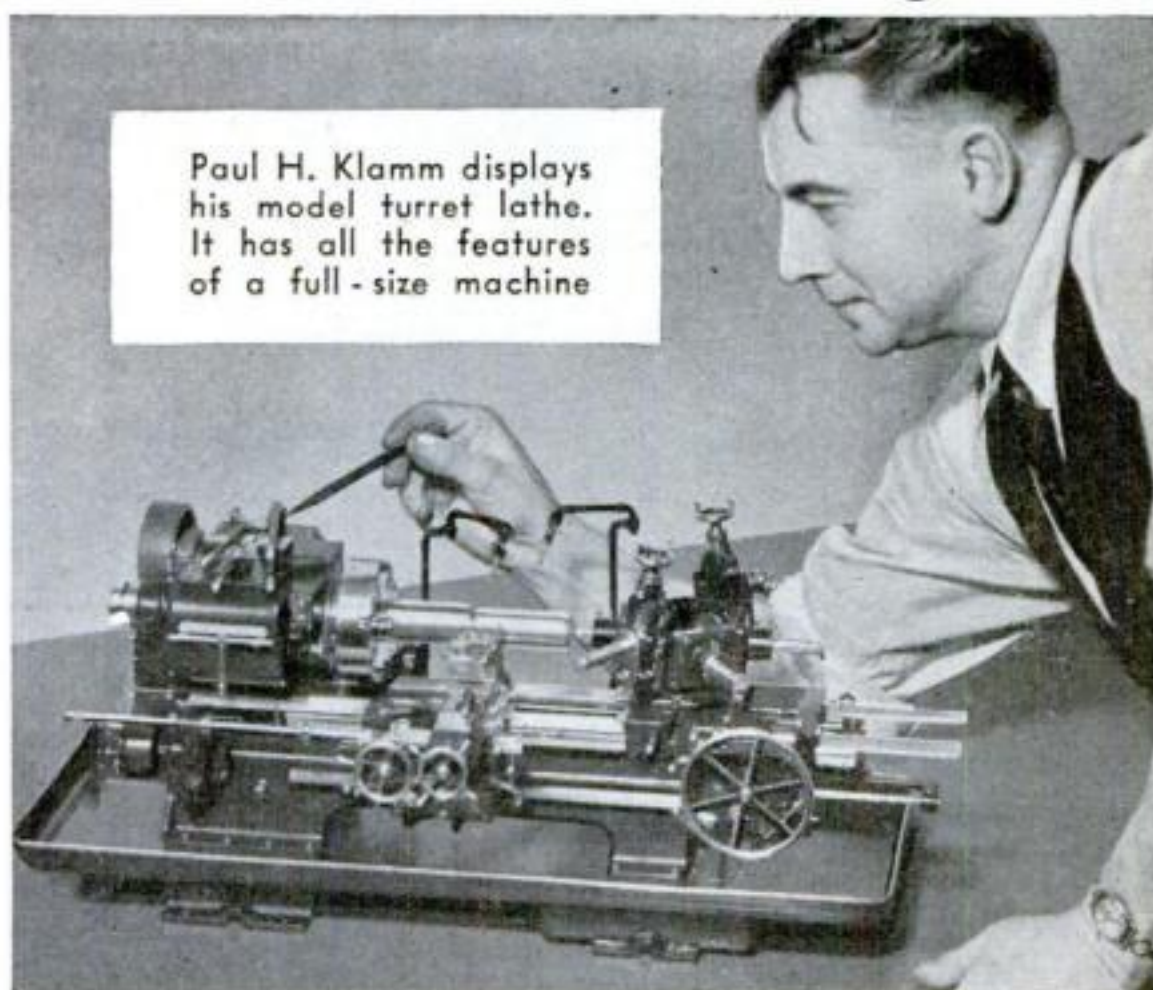
Mrs. James Campin with a favorite spider-web painting, a study of a kitten. She has done about sixty pictures



PAINTING on spider webs is the novel art practiced by Mrs. James Campin, who lives on a farm near Shenandoah, Iowa. Struck by the beauty of raindrops on cobwebs, she found that oil paints would stick to the gossamer threads and dry there more quickly than on canvas. Just any cobweb won't do, she says; it must be firm and well spread, representing about three weeks' work by a spider. Stretched across a cardboard frame, the painted web is preserved between panes of glass.

Model Turret Lathe Works Like a Big One

ABOUT 1,200 hours of spare-time work went into the construction of a miniature turret lathe built by Paul H. Klamm, an employee of a Cleveland, Ohio, machine-tool manufacturing concern. Patterned after a large lathe built by Klamm's own company, the twenty-inch-long model has every feature of the full-size machine, including turrets that actually index, a headstock adjustable for a wide range of speeds, and a miniature oil pump that circulates cooling liquid. Although some of the gears are as small as a quarter of an inch in diameter, every part of the tiny machine works.



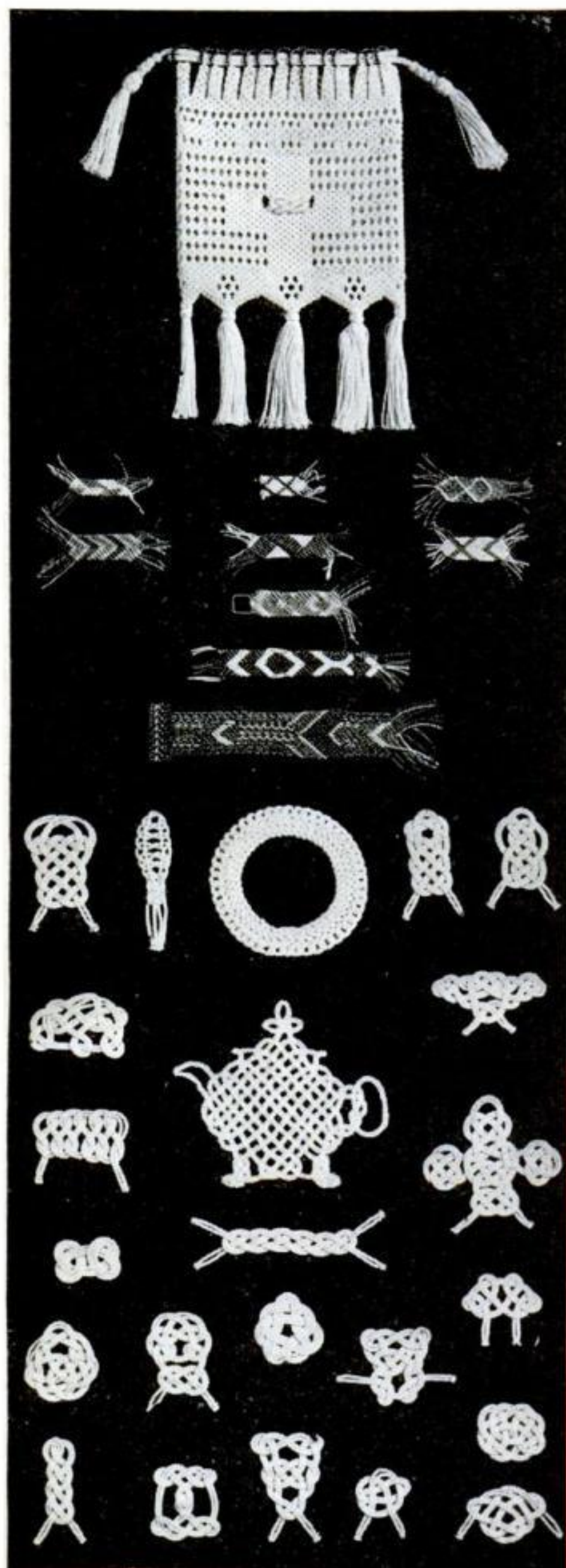
Paul H. Klamm displays his model turret lathe. It has all the features of a full-size machine

KNOTS

TRACKING down knots and knot lore across the whole surface of the earth, has been the lifelong hobby of Raoul Graumont and John Hensel, merchant seamen. Graumont's interest began when, as a boy, he first shipped on sailing vessels under the French flag. Hensel, a Danish-American, began collecting knots as a youngster aboard American freighters. Both temporarily out of work, about four years ago, they ran into each other on the "beach," New York's old South Street where seamen look for jobs. A friendship was immediately struck up, knot collections—running into trunkfuls—were pooled, and plans were begun to collaborate on a knot encyclopedia surpassing in size and scope anything ever before attempted.

Completed just a few months ago, this book describes and pictures 3,200 knots. Intricate knot fancywork developed aboard sailing ships is shown side by side with practical directions for tying a horse or stringing up the clothesline. Ornamental knots, magic

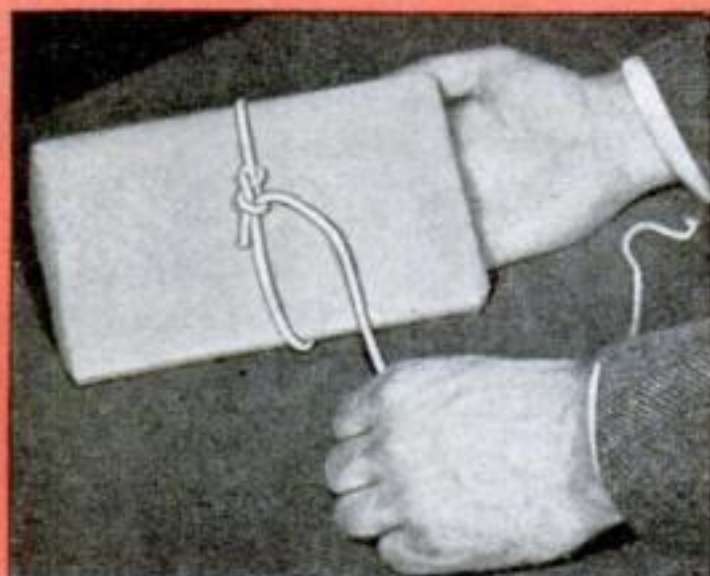
By **ARTHUR A. STUART**



Examples of fancy knot work in the collection of John J. Hensel and Raoul M. Graumont. The upper panel holds a handbag and some knotted belting



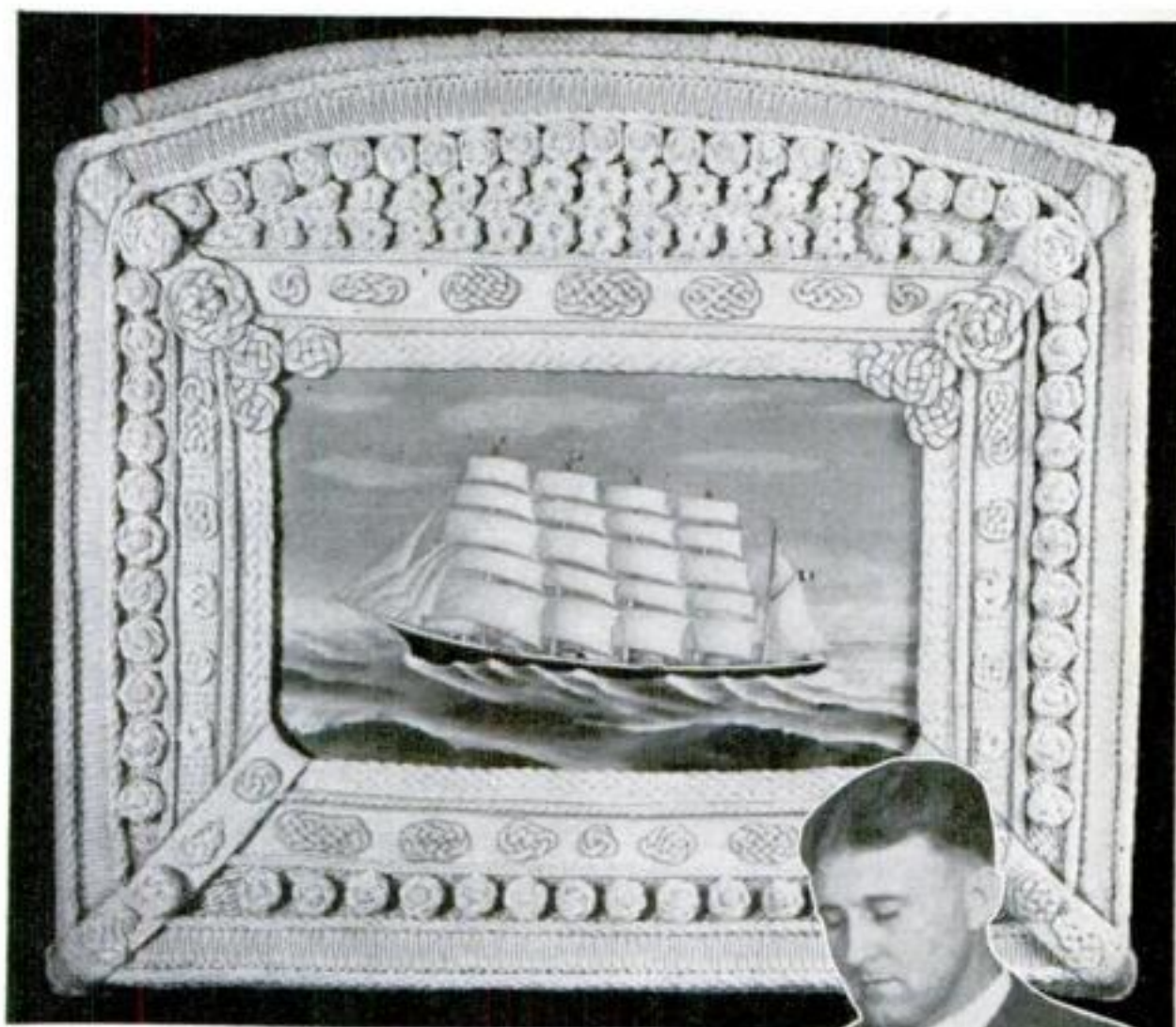
A good-luck ring knot learned from Philippine headhunters. The two hobbyists challenge anybody to tie one like it



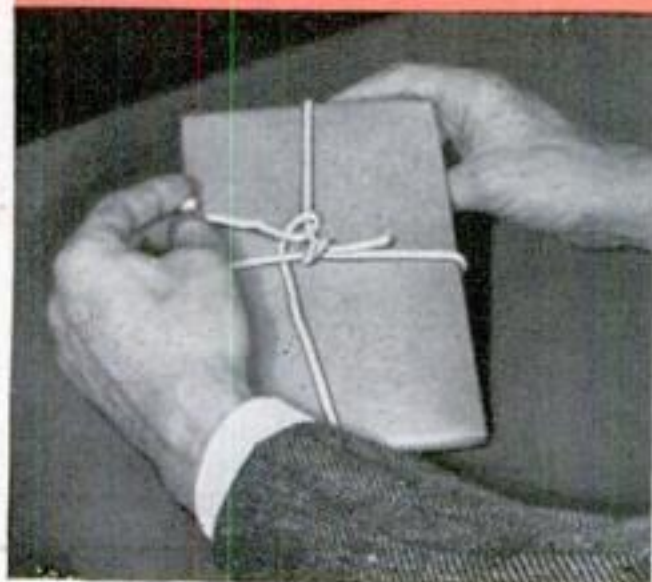
FOR A HOBBY

knots, sailors' and riggers' knots, mix with foolproof knots for your shoe laces.

To collect the enormous amount of data needed for their volume, Graumont and Hensel searched through rare old books, and through museums in America, Europe, and Asia. They rubbed elbows with old sailors, builders, weavers, fishermen, and other rope specialists. In Istanbul, Turkey, Graumont bartered for days with a native for a queer tassel knot which fascinated him. In the Philippines, he got a rope ring from the medicine man of a tribe of former head-hunters. It was a good-luck ring, and he was cautioned never to divulge how it was made, under penalty of breaking its magic spell. So unusual is its weave—a rare Turk's-head pat-

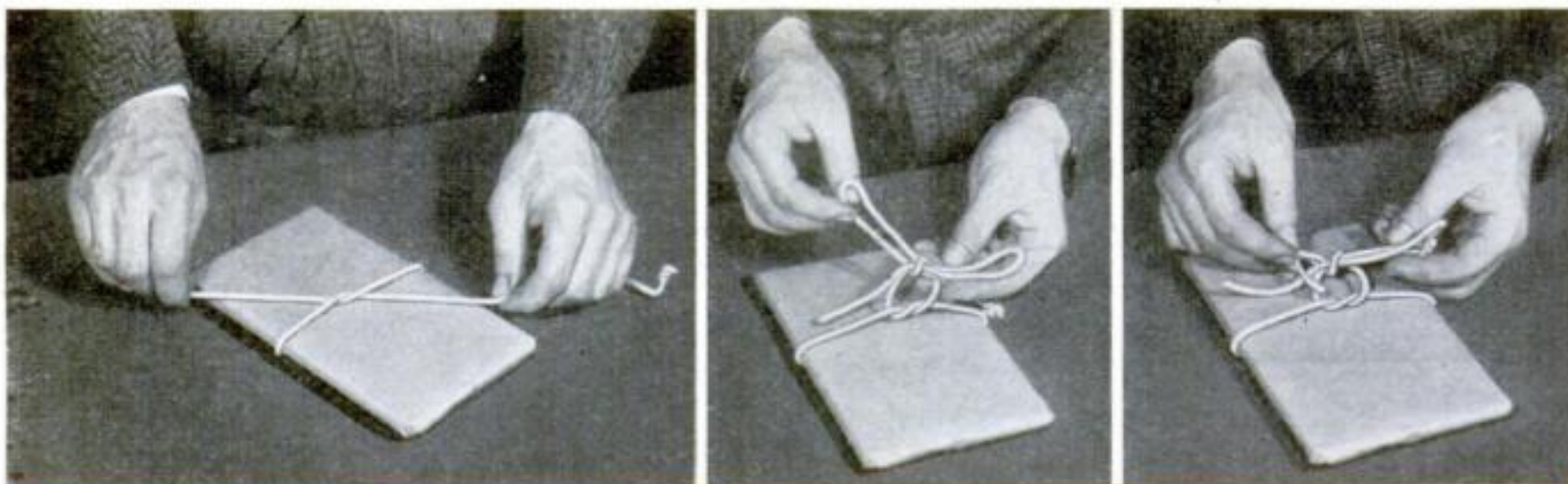


Hensel and Graumont at work on their knot encyclopedia. Above them is a huge picture frame of knots on which they worked eight hours a day for three months



TRY THIS WAY OF TYING A PACKAGE

Pass a loop around the package and secure it with a figure-8 knot, as shown at far left. This holds tight while cord is passed around the other way and tied again. An extra hitch gives added security



Do you have trouble keeping your shoe strings tied, especially with new laces? Here's the knot that will hold them. Begin as usual . . .

. . . and tie the bow in the regular way, but do not pull it tight. Pass one of the loops of the bow through the open knot as shown above

tern—that Graumont is ready to challenge all comers that they cannot tie it, even after close examination of the ring!

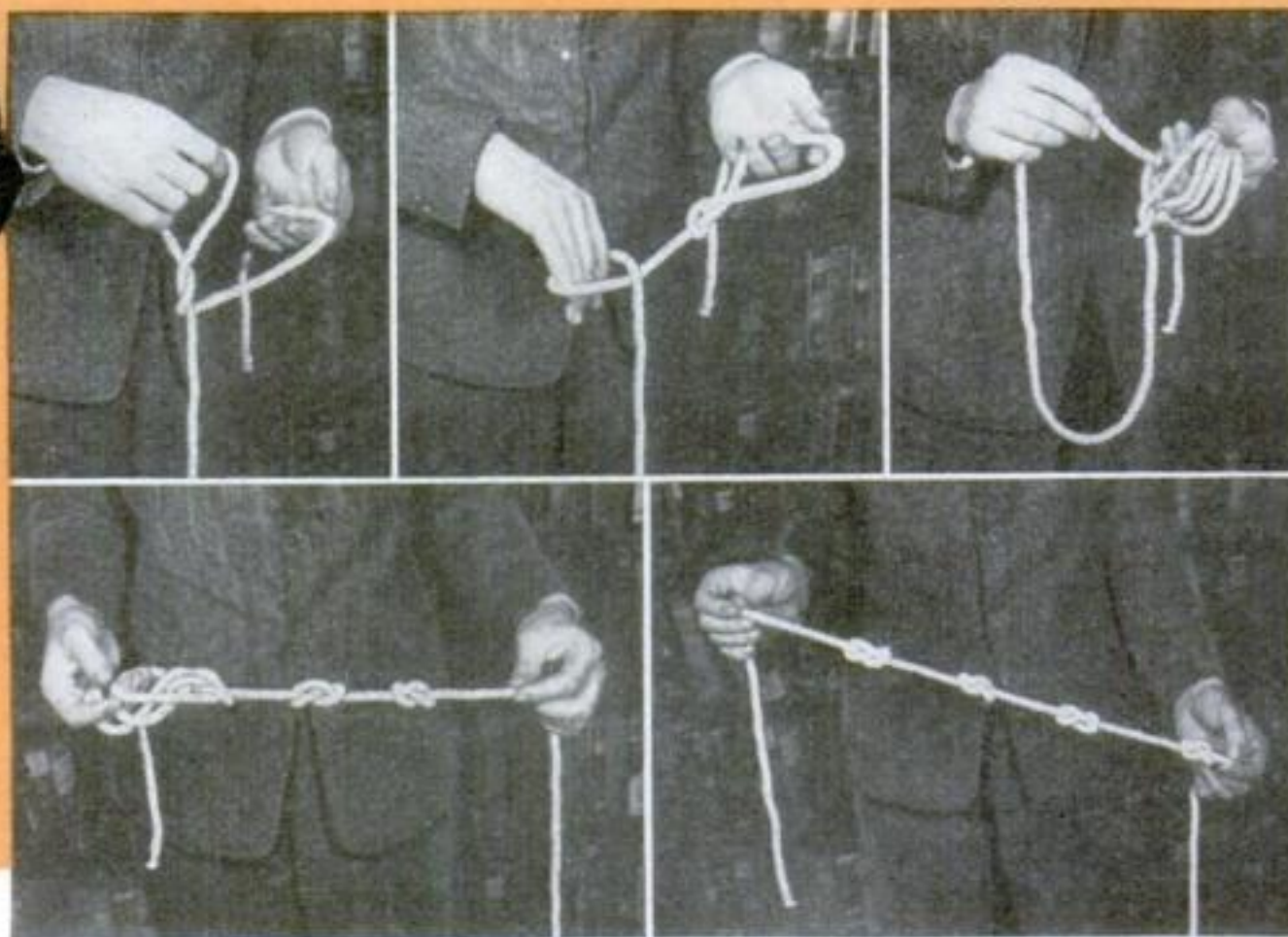
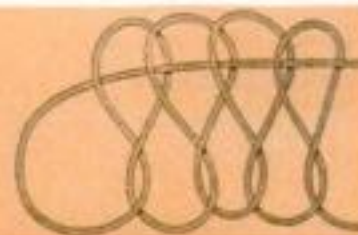
Among primitive peoples, knots have often been associated with magical powers. Many wizards and witches claimed they could tie up the wind in knots, and sailors, notoriously superstitious, would buy charmed cords of knots to be untied when they were becalmed at sea. Such beliefs were common in Lapland, Finland, and other northern countries, particularly among seafaring men. Another belief was that knots could

either cause or cure illness. For instance, a person with a fever could rid himself of it by tying knots in the limbs of a willow tree—one for each day of the fever. Then, by chanting certain magic words, the tree would acquire the fever and the patient be cured!

Probably the oldest form of recognized knot work is the beautiful ornamental knotting which began its development in China and Japan, thousands of years ago, and which was often associated with religious symbolism. Similar fancy knots were common in Europe during the Middle Ages, as



This bit of knot magic makes a good stunt for a party. Follow the successive steps shown in the photographs. In a dramatic gesture you produce a series of figure-8 knots spaced along your cord

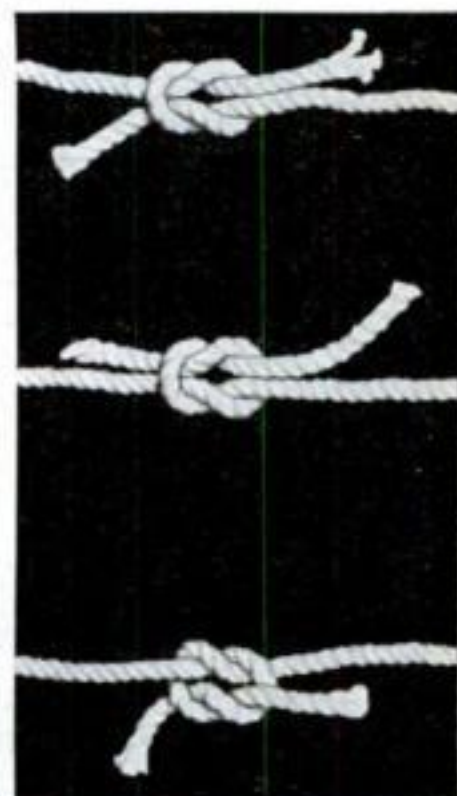
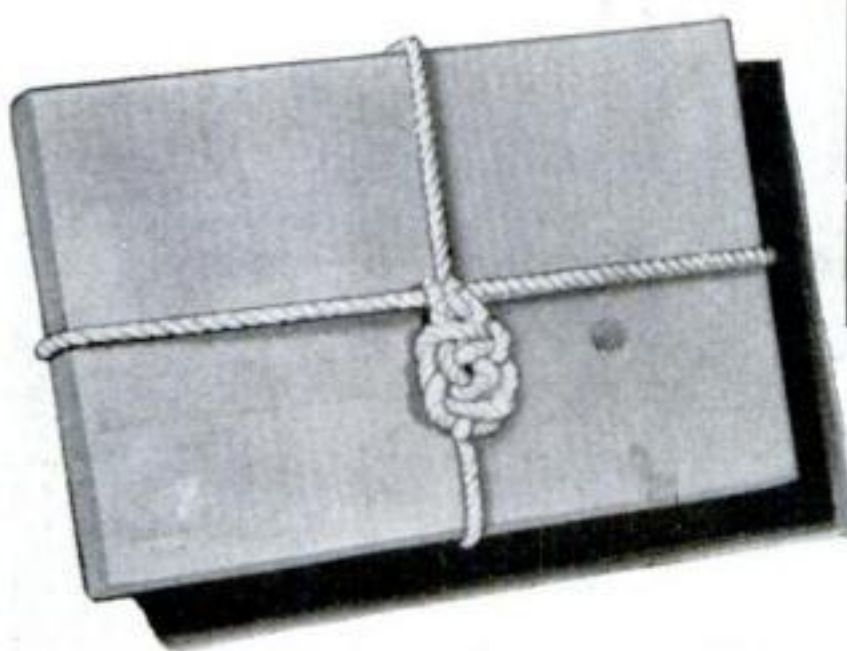




Now pull out the loops as usual and tighten the knot. The finished knot will never slip out, but can be untied like an ordinary bow, by yanking the loose ends

figures in heraldic designs. One knot was known as the "brief knot," and was used in place of a seal to prevent tampering with important packages. The elaborate knot was first tied, and then the ends cut short. It was impossible to untie the knot and retie it, without detection.

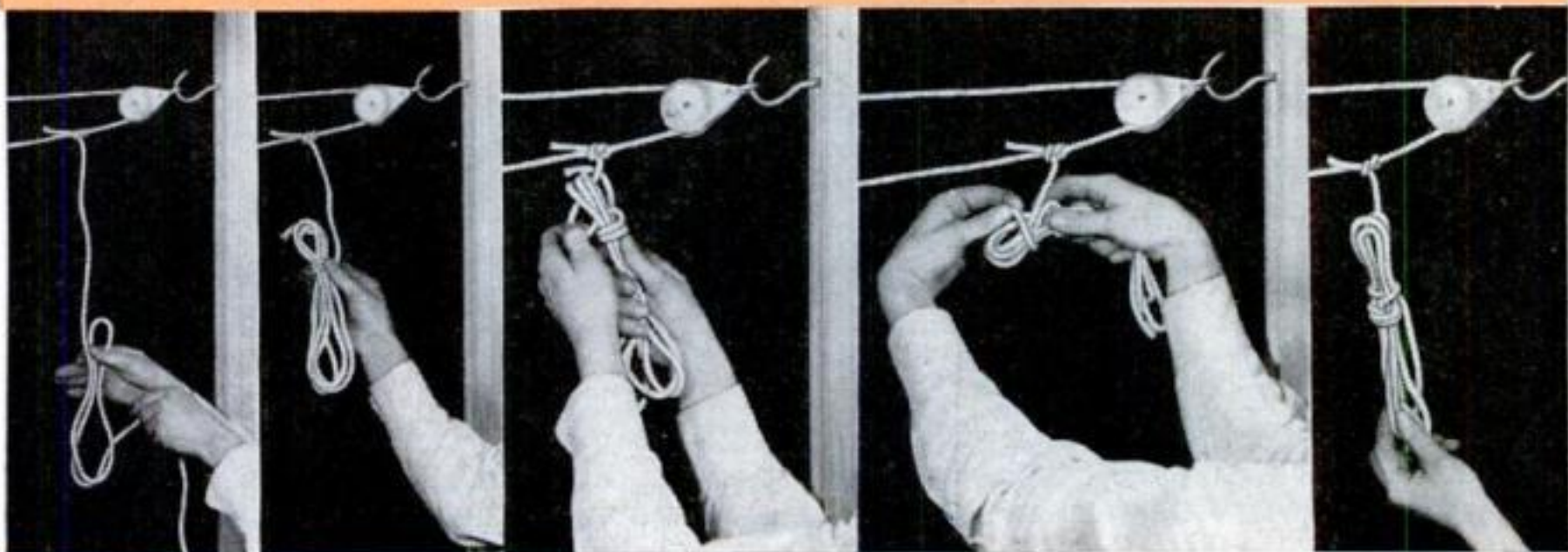
In running down knot lore, Hensel and Graumont discovered dozens of other knot hobbyists among men in all walks of life, including sailors, soldiers, surgeons, cowboys, farmers, magicians, anthropologists, yachtsmen, and statesmen. One physician was so enthusiastic about knots that he hired Hensel as a private tutor, to give him further instruction. The late King Albert of Belgium was a knot fan, as is Edouard Daladier, former Premier of France. Secretary of State Cordell Hull is an expert at tatting, which is a form (*Continued on page 215*)



Three knots that look a little alike: top to bottom: thief knot, square or reef knot, and granny. Left, brief knot used to guard secret documents

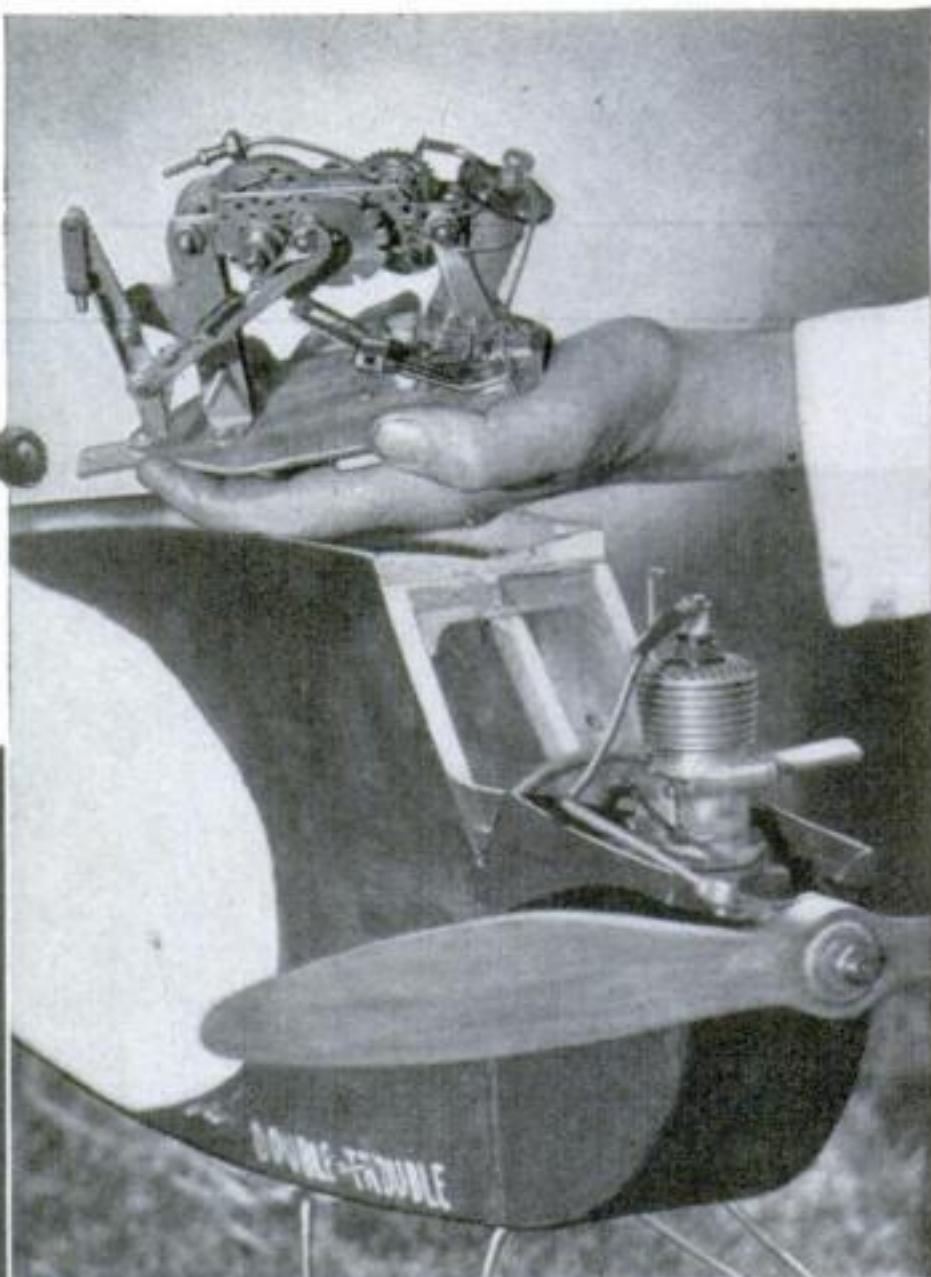
To tie up the loose end of a clothesline, coil the extra rope and make several turns around the upper end of the coil as shown

Now make a loop in the hanging part and put it through the loops of the coil. Bring this loop up, pass it over the coil, and tighten



Tiny Clockwork Pilot Stunts Model Plane

James A. Carney's tiny acrobatic plane takes off on a stunt flight

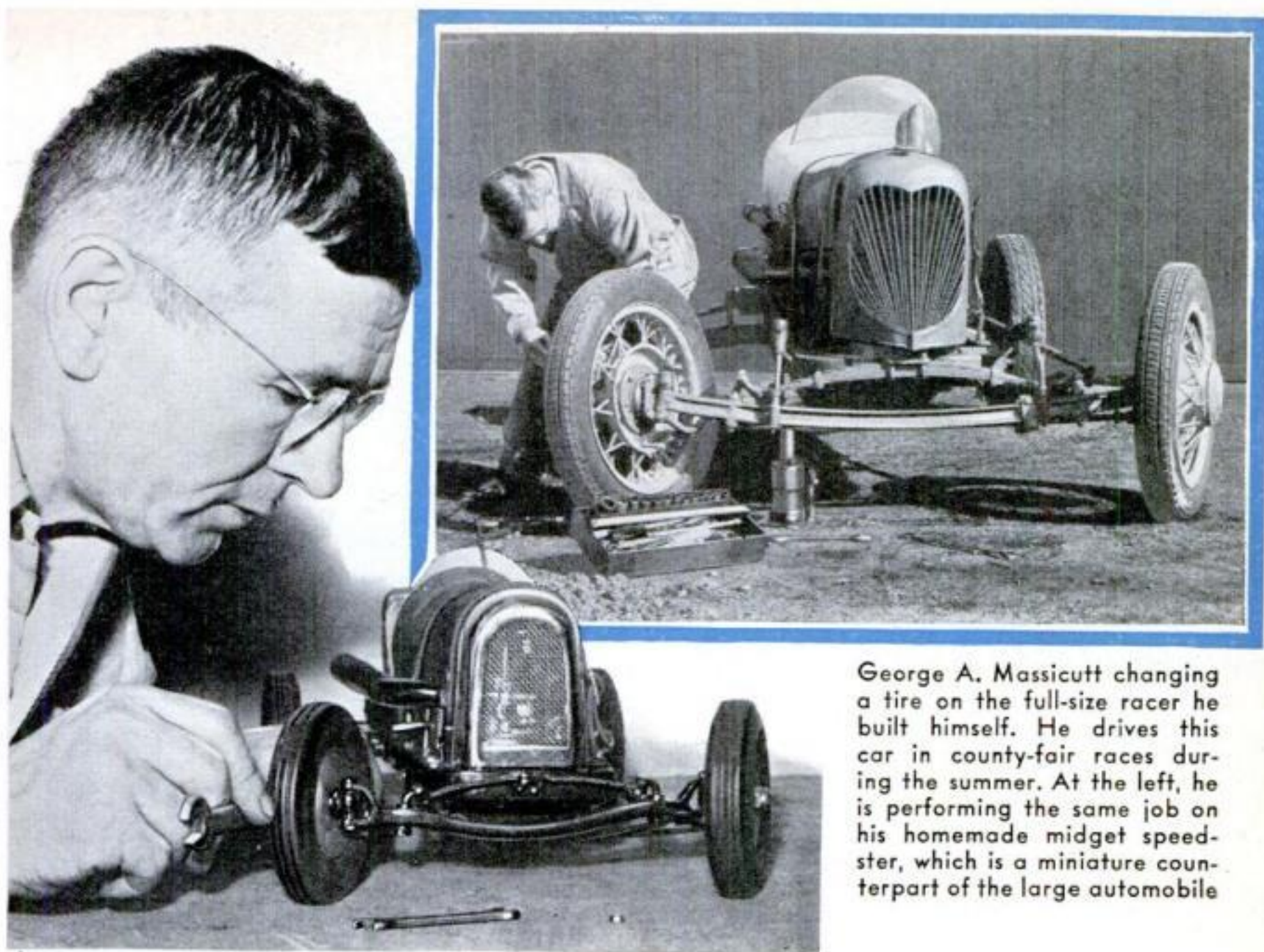


This is the mechanical pilot removed from the plane. Made from the innards of a clock, it operates the controls

At the left, the builder is seen with the model. The control device is mounted in the fuselage

CONTROLLED in the air by a home-made automatic "pilot," a gas-powered model plane constructed by James A. Carney, San Antonio, Tex., model-plane enthusiast, performs loops, half rolls, and Immelmann turns. Two sets of interchangeable wings are used on the four-pound ship, one set for performing loops, and one for its other aerobatic stunts. The control mechanism, which utilizes the spring motor of a clock, is made of aluminum and brass, with holes drilled in solid parts to save weight. Carney fitted a special timer

into the mechanism in such a way that after the ship takes off and climbs to about 100 feet, the spring-powered control goes into operation, working the ship's ailerons and rudder to send it into a loop or half roll. When looping, the mechanism puts the ship into a dive for five seconds to gain momentum. Then the controls are shifted to pull the craft into a five-second climb, sending it into a complete loop. At the right instant, the mechanical pilot straightens out the ship's flight. As many as nine consecutive loops have been made during one flight.



George A. Massicutt changing a tire on the full-size racer he built himself. He drives this car in county-fair races during the summer. At the left, he is performing the same job on his homemade midget speedster, which is a miniature counterpart of the large automobile

He Races Cars...from Giants to Midgets



Tethered by a cable, the tiny car gets away in a race against time

THERE'S just as much of a thrill in racing a model car as a full-size one, and a lot less expense. So declares a man who has tried both—George A. Massicutt of Long Island City, N. Y., chief mechanic for a nation-wide bus system—after spending thirty-four of his fifty years on motor cars.

A veteran of speed competitions with such famous champions as Louis Chevrolet and Barney Oldfield, Massicutt now indulges his racing enthusiasm throughout the year. At county-fair events in the summer, he pilots a racing car of his own construction,

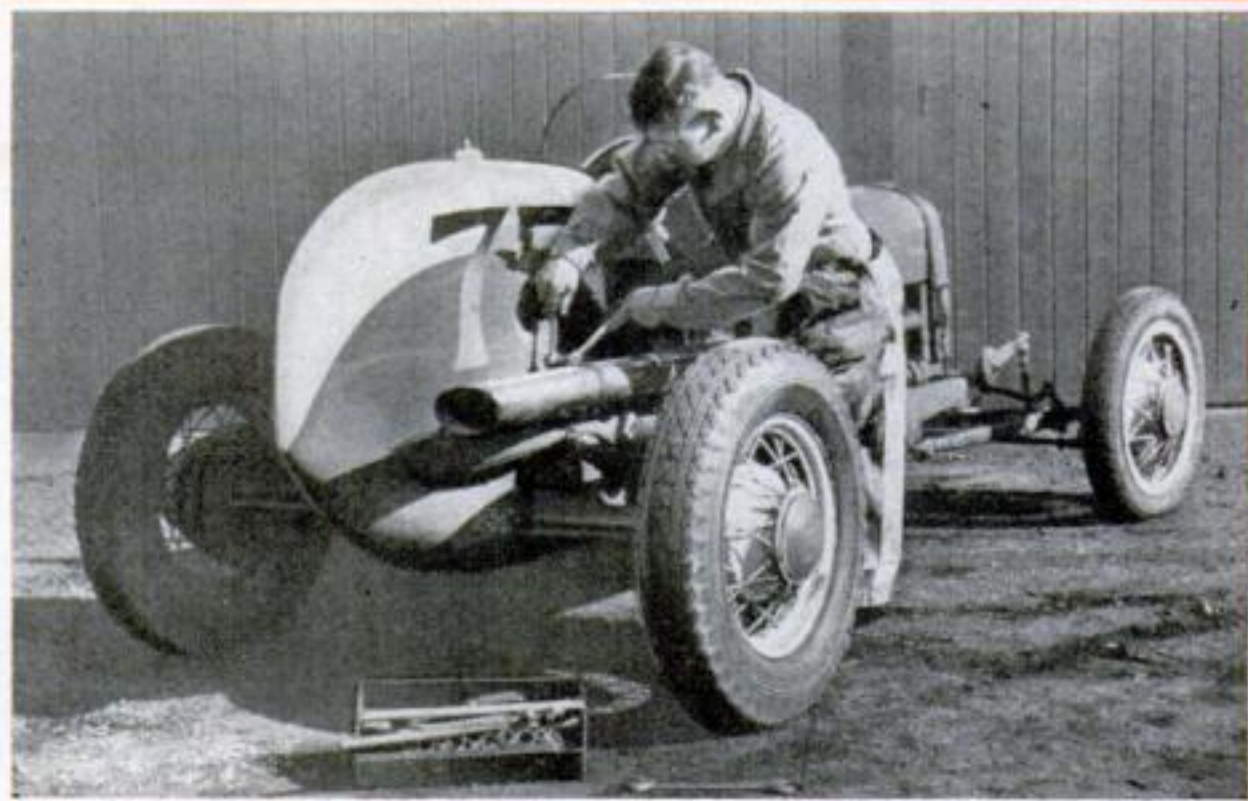
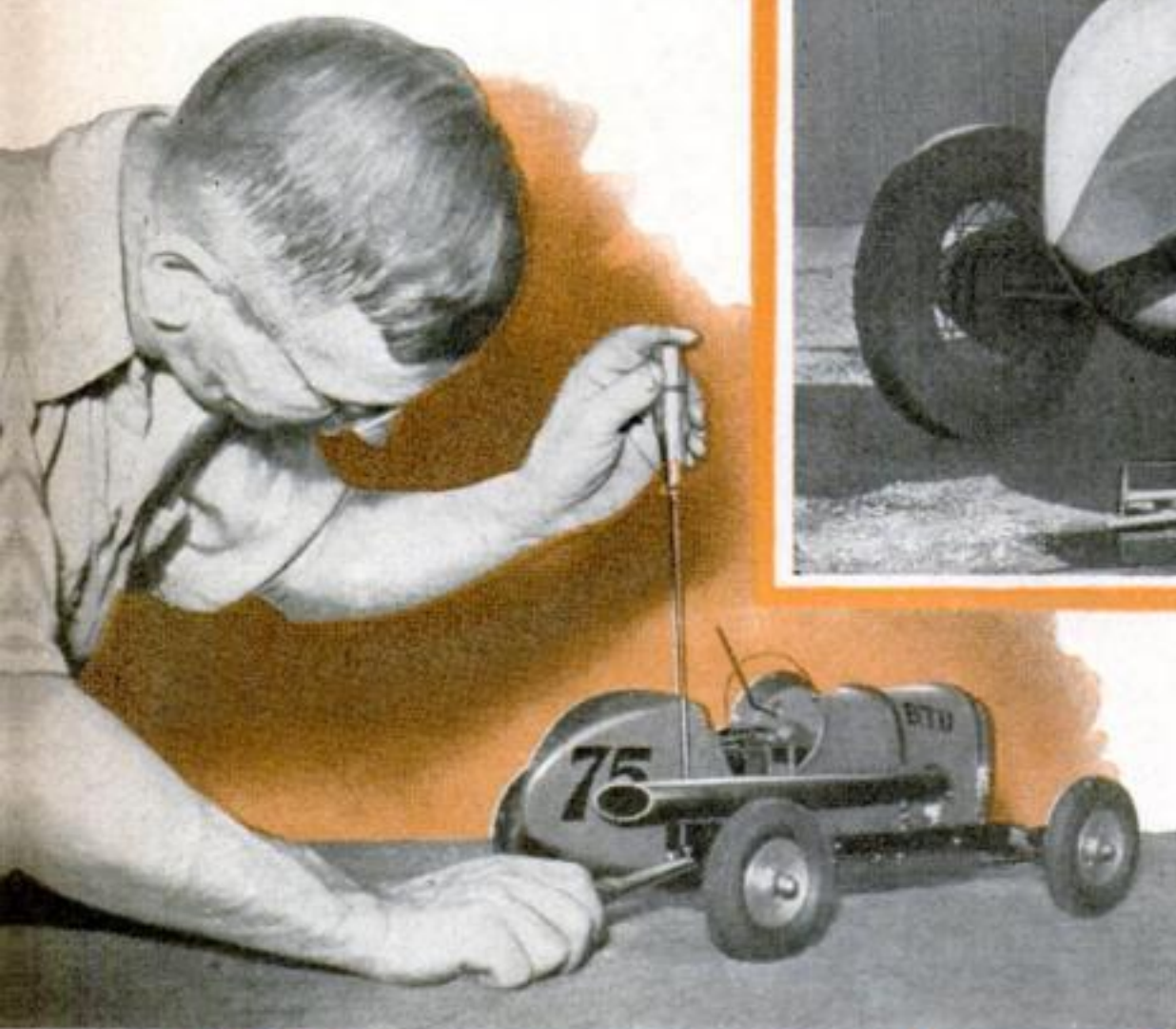
capable of turning up 150 miles an hour. During the winter, he competes in indoor races for model gasoline-powered automobiles, conducted weekly by the Greater New York Midget Model Racing Association.

In this increasingly popular sport (P.S.M., Feb. '40, p. 61), each contestant's model is tethered in its turn to a central post. Started by its owner, it buzzes around and around a circular track in a race against the clock. Many of the fans assemble their machines from standardized parts supplied in kits.

Massicutt, however, has patterned his entry after his own man-carrying racer. With the exception of the quarter-horsepower motor, he made every part of the model

himself. Over a course of a third of a mile, his diminutive machine has been clocked at better than mile-a-minute speed!

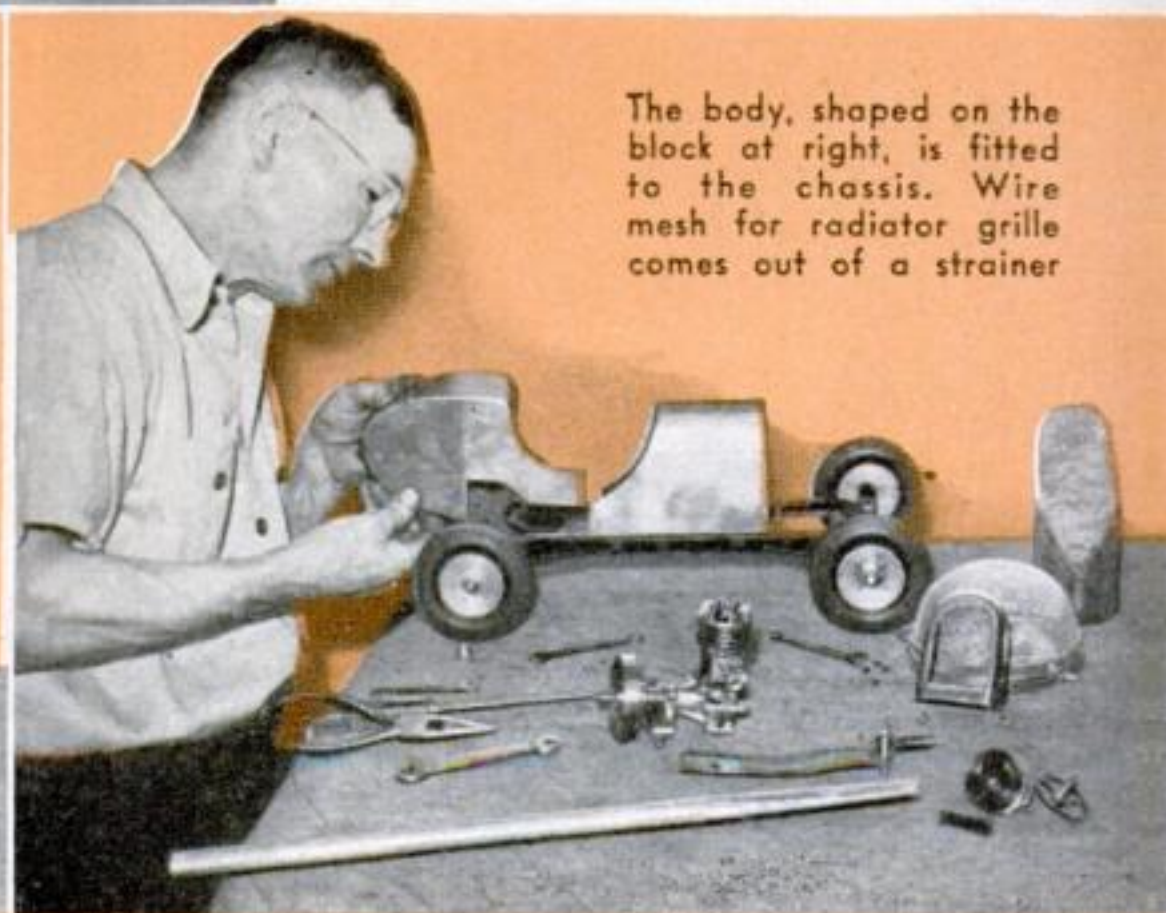
For the chassis, he employed molybdenum steel, in order to combine light weight with great strength. A tea strainer supplied the wire mesh of the radiator. Following the design of his full-size racing car, he fashioned a front-end assembly with single-point spring suspension and authentic torsion knuckles and king-pins. His final touch is a hand-towed "trailer" for his model, simulating the auto-towed trailer that carries his big car to the race track.



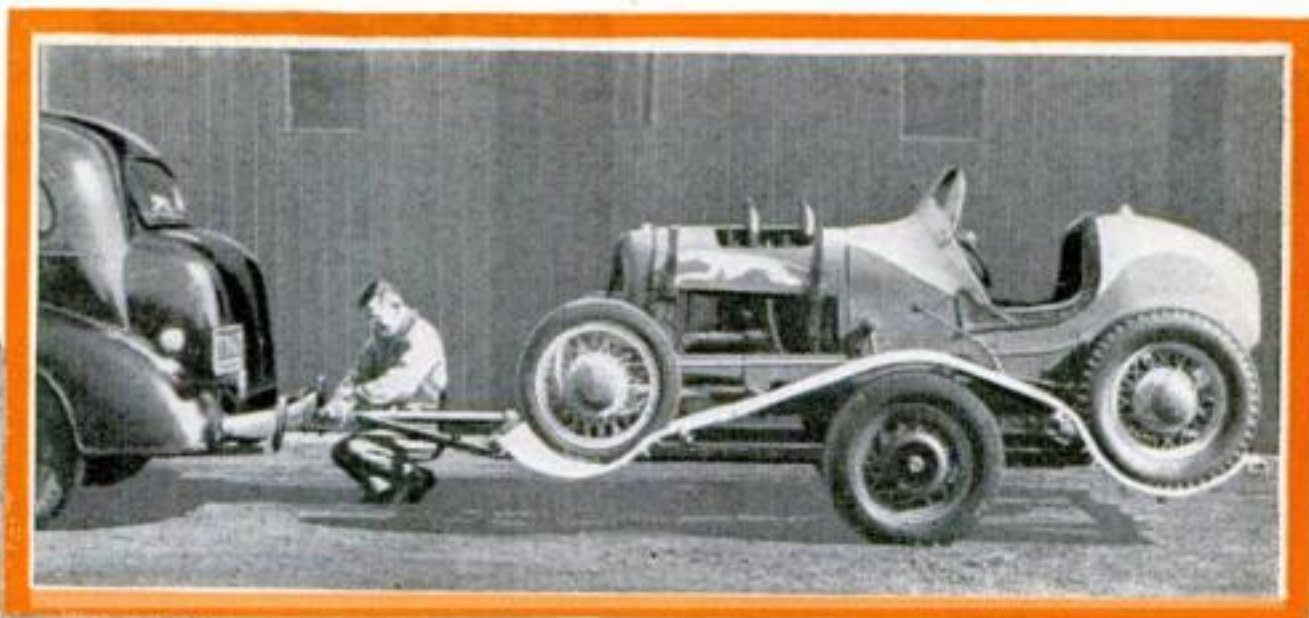
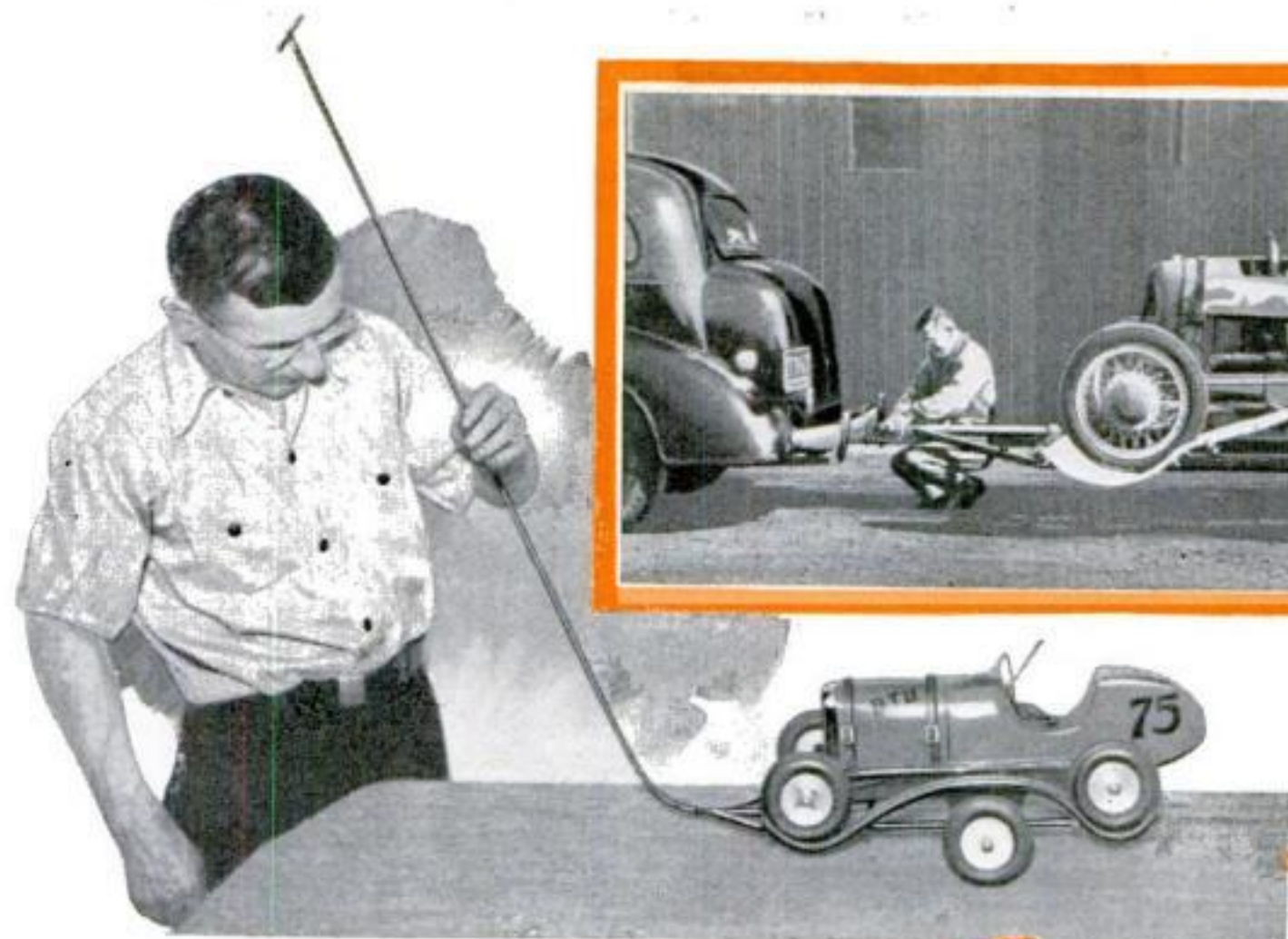
Anchoring the exhaust pipe to the rear of the big car's chassis. The same exhaust-pipe arrangement on the model, as shown at the left, not only adds realism but actually increases the speed by producing a rocketlike effect that helps to kick the tiny car around the course



Massicutt building his midget racer. Here he is shaping the cowling from metal cut with the aid of templates. Note the lightweight chassis

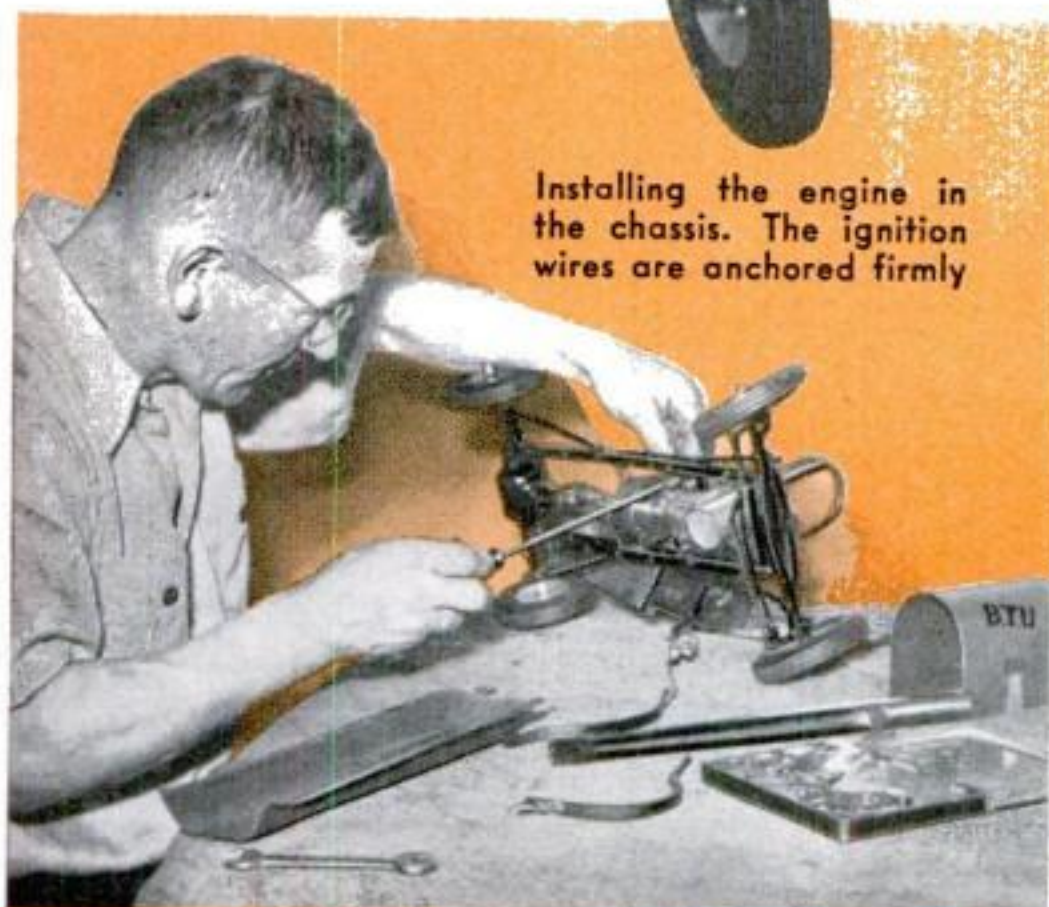
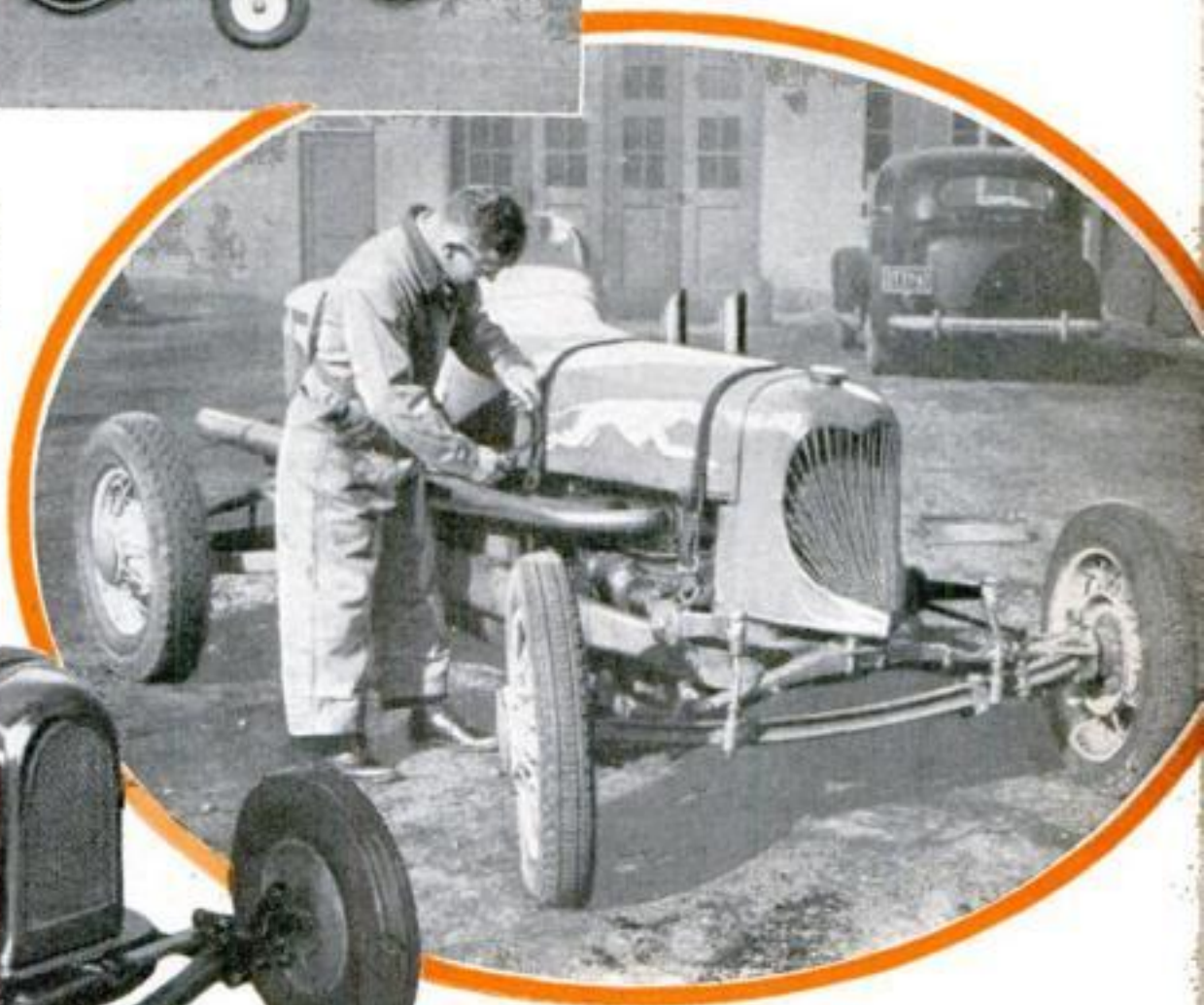


The body, shaped on the block at right, is fitted to the chassis. Wire mesh for radiator grille comes out of a strainer

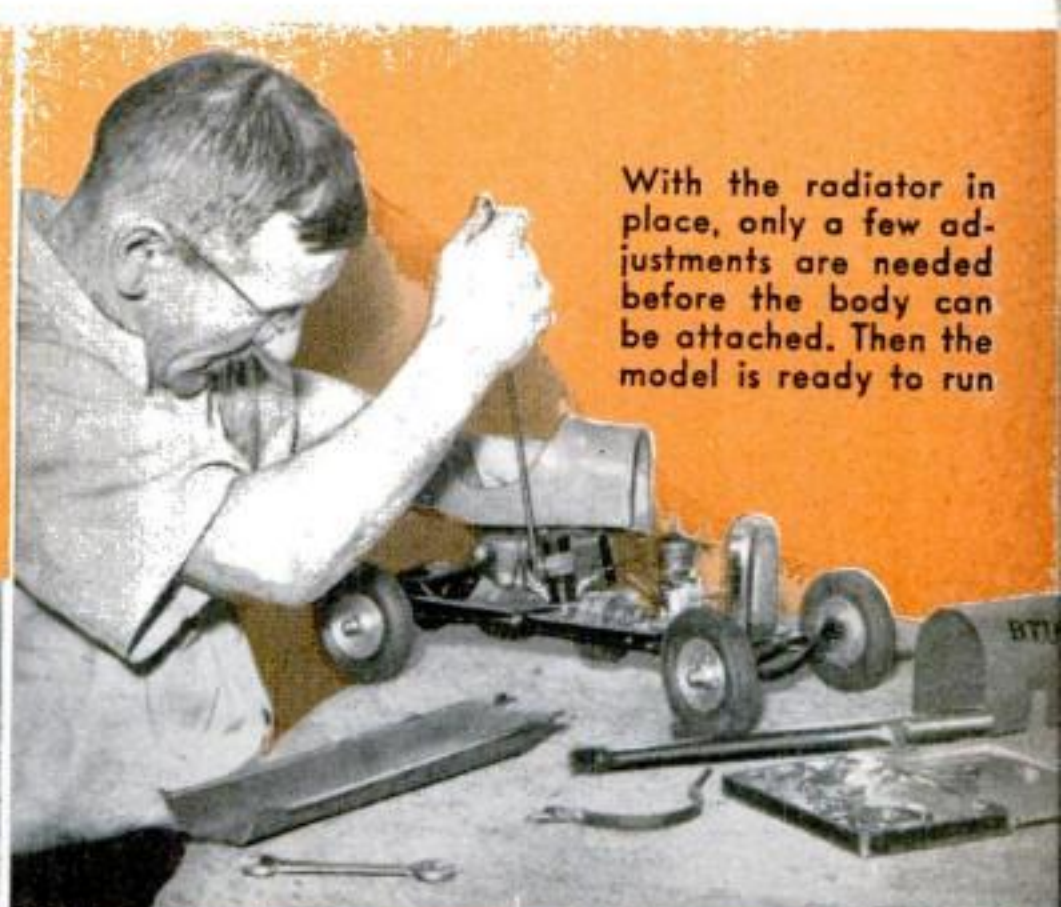


Like the big racer, above, the tiny car has a specially designed trailer for taking it to a track

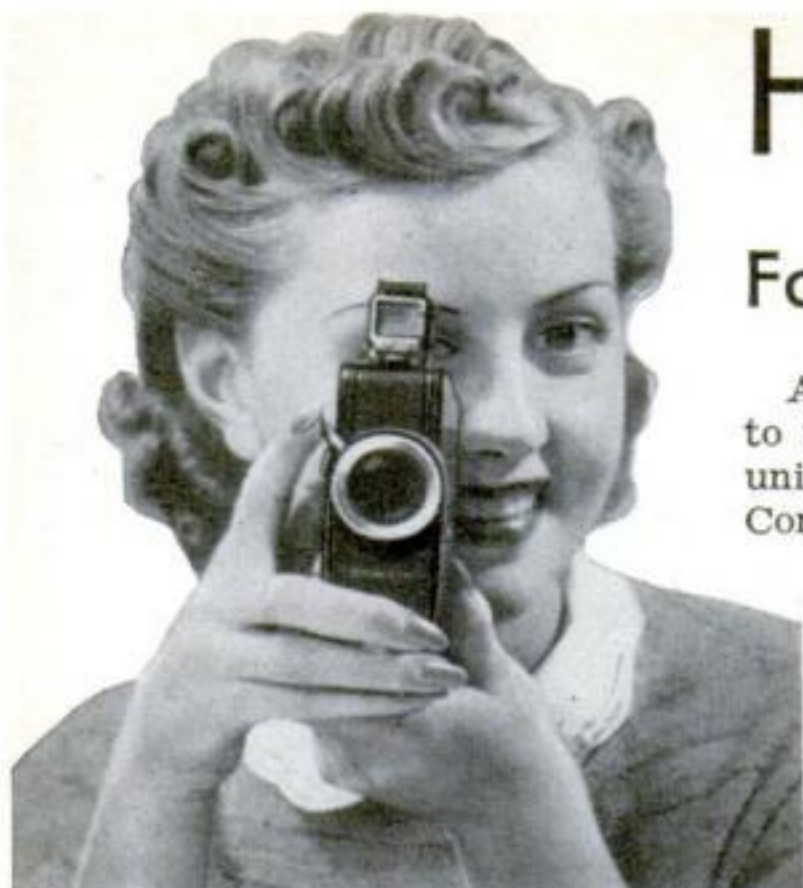
Real straps with spring fasteners, like those seen at the right on the full-size car, keep the hood of the model from flying off at high speed



Installing the engine in the chassis. The ignition wires are anchored firmly



With the radiator in place, only a few adjustments are needed before the body can be attached. Then the model is ready to run



A finger on the knob easily controls fade-outs

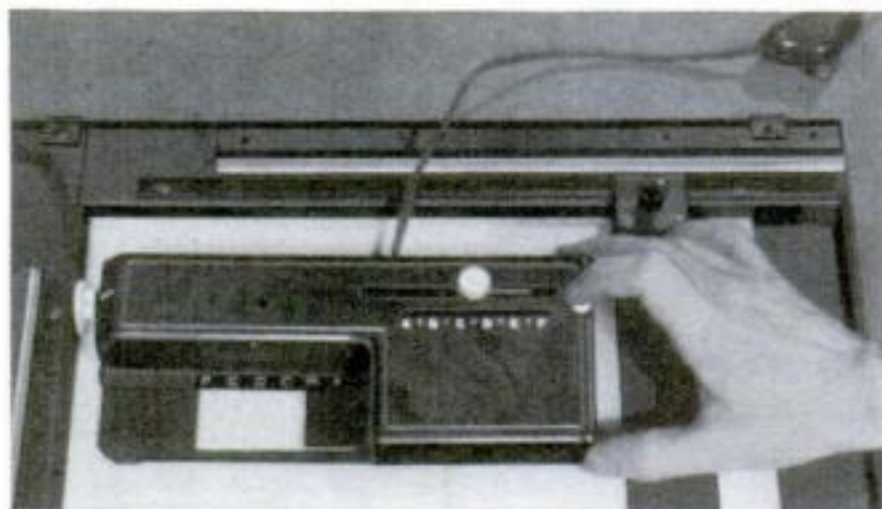
HELPS FOR

Fade-Out Unit Fastens to Lens

AMATEUR movie makers can add a professional touch to their films with the aid of a new optical fade-out unit that fastens over the lens of any movie camera. Containing two concentric lenses of light-polarizing glass, one of which is stationary, while the other can be rotated through a half turn, the device gradually blocks off all light from the film as a small knob is moved, resulting in a fade-out of the scene. It also may be used for fade-ins. In addition, by fading out a scene, rewinding the film, and fading in a new scene, a "lap dissolve" is obtained, providing a smooth transition between two sequences of the movie.

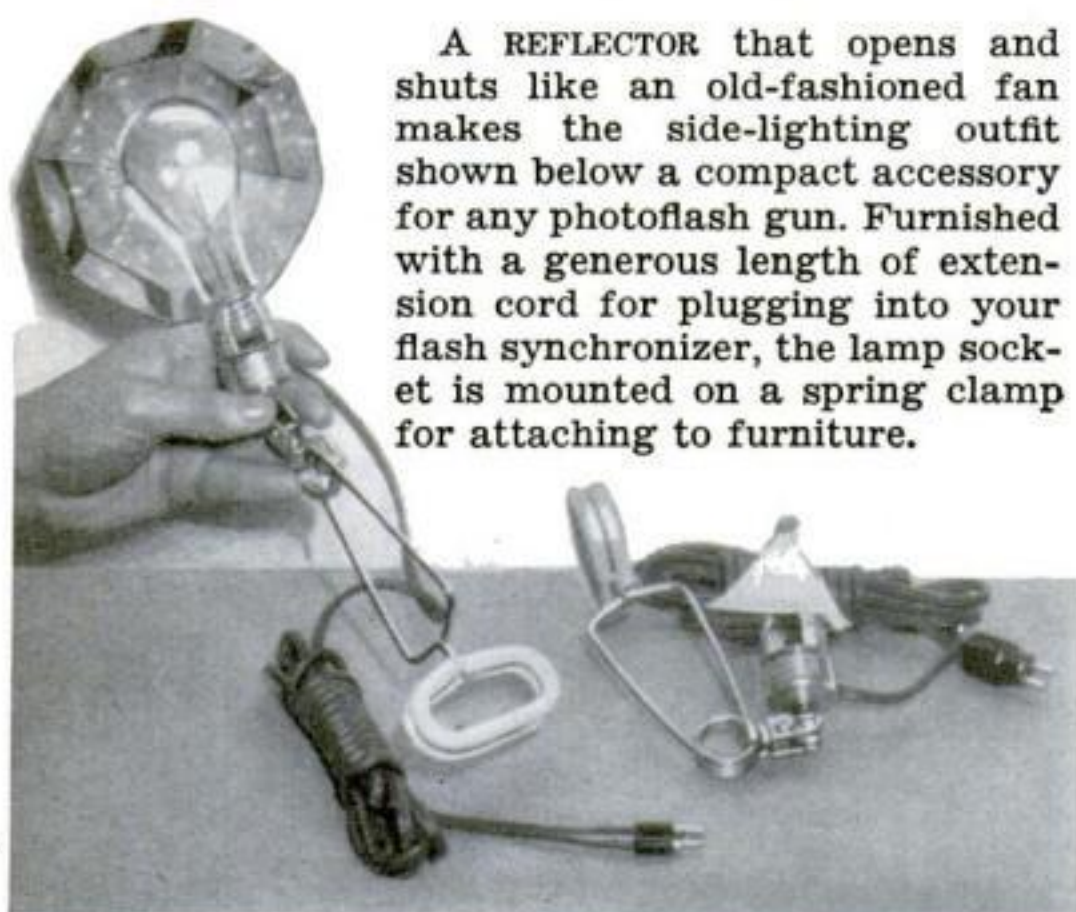
Tester Finds the Best Enlarging Exposure

CONNECTED directly to the circuit of an enlarger lamp, the apparatus shown at the right first makes test strips at several preset time exposures, then automatically repeats any exposure selected to make an enlargement. In use, the unit is placed on the enlarging easel on a strip of test paper. Adjustable knobs are set and the mechanism started. After development of the strip, the proper exposure time is selected. Later, the unit becomes a timing switch for repeating the desired exposure as often as it is necessary in making the actual enlargements.

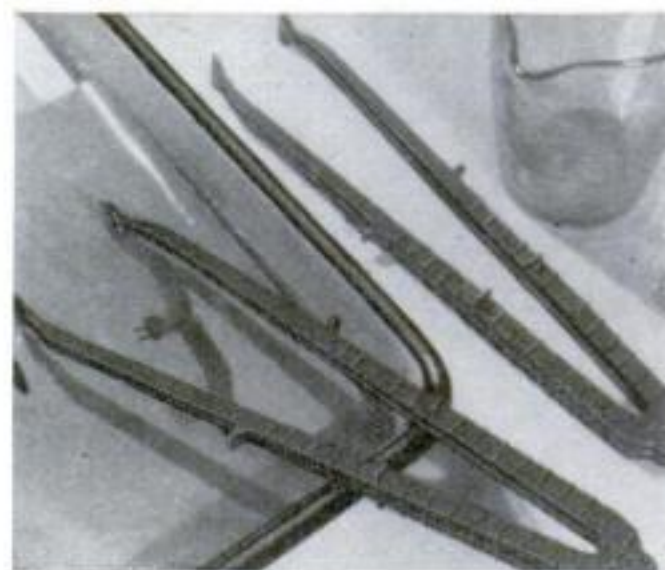


In use, the tester is wired to the enlarger lamp

Compact Side-Lighting Outfit



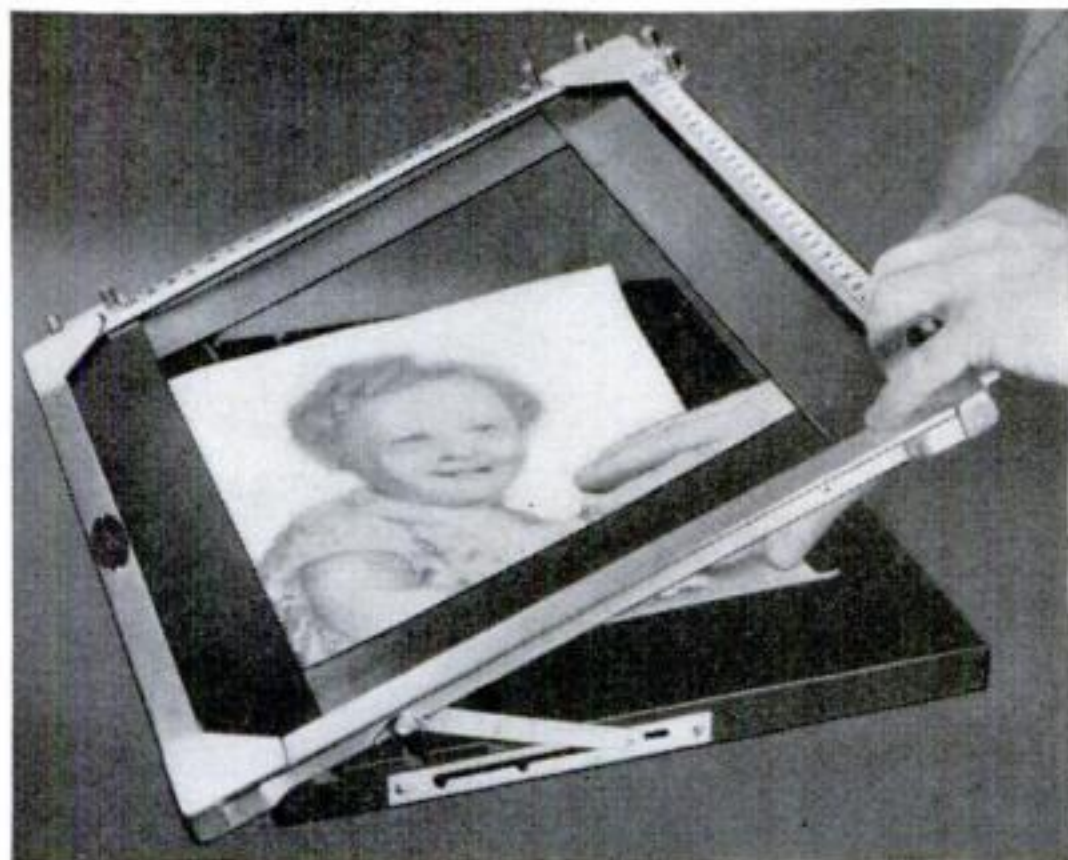
The reflector folds up like an old-fashioned fan, as at right



Nonskid Film Tongs Made of Plastic

MOLDED-PLASTIC tongs in red and black pairs will help prevent photographers from getting them mixed up. Fretted grips make them easy to hold, while stops prevent them from sliding into the chemical baths when they are rested on the edges of trays.

PHOTOGRAPHERS



Automatic Enlarging Easel

THE automatic enlarging easel shown above instantly centers any of three popular sizes of enlarging paper. Masking strips move easily into the proper positions for the paper size selected, and are held firmly in place by spring controls on the measuring scales. The entire masking frame is hinged, and a locking device holds it up so that both hands are free for inserting the enlarging paper. If desired, a corner of the easel may be used without taking advantage of the centering device.

Dry Cell Operates New Bulb Checker

SIMPLE to use and small enough to fit in your coat pocket, the dry-cell-operated tester below shows you instantly whether flash and flood bulbs are good. Lifting the lid of the tester exposes a lamp socket into which the bulb is pressed. A tiny cell furnishes current to light a midget lamp if the bulb is in working order. The manufacturer claims that the tester works with all bulbs.



If the flash bulb is good, a tiny lamp lights. The device fits in your pocket

Handy Kit Dries Enlargements Quickly

ENLARGEMENTS and contact prints may be dried in a minimum of time with the aid of the materials shown in the accompanying illustrations and recently made available in kit form. A sheet of stiff composition board is folded as pictured to form the supporting frame. Pieces of heavy corrugated cardboard, blotting paper, and the prints to be dried are then stacked within the side walls of the frame, layer on layer. Drying may be speeded up by forcing air from an electric fan through the corrugated layers. A large number of photographs may be dried at once.



Prints dry quickly between sheets of corrugated cardboard and blotting paper



Camera Fans Run



PIXILATED PICTURES presents "Frankenstein"! That is the announcement of a full-length sound movie produced, cast, directed, and photographed by a group of high-school amateur camera fans in San Antonio, Tex., who have presented four other productions since they organized themselves as a motion-picture producing company three years ago. Pixilated Pictures was launched in 1937, with the sale of stock at ten cents a share and the production of a breath-taking drama, "Dr. Jekyll and Mr. Hyde," which rolled up box-office profits large enough to allow the directors to declare a 100-percent dividend and raise the stock to twenty cents a



Young movie makers in action: above, cutting and splicing film; at left, operating a projector and phonograph for synchronized sound. Below, filming a creepy scene in "Frankenstein"

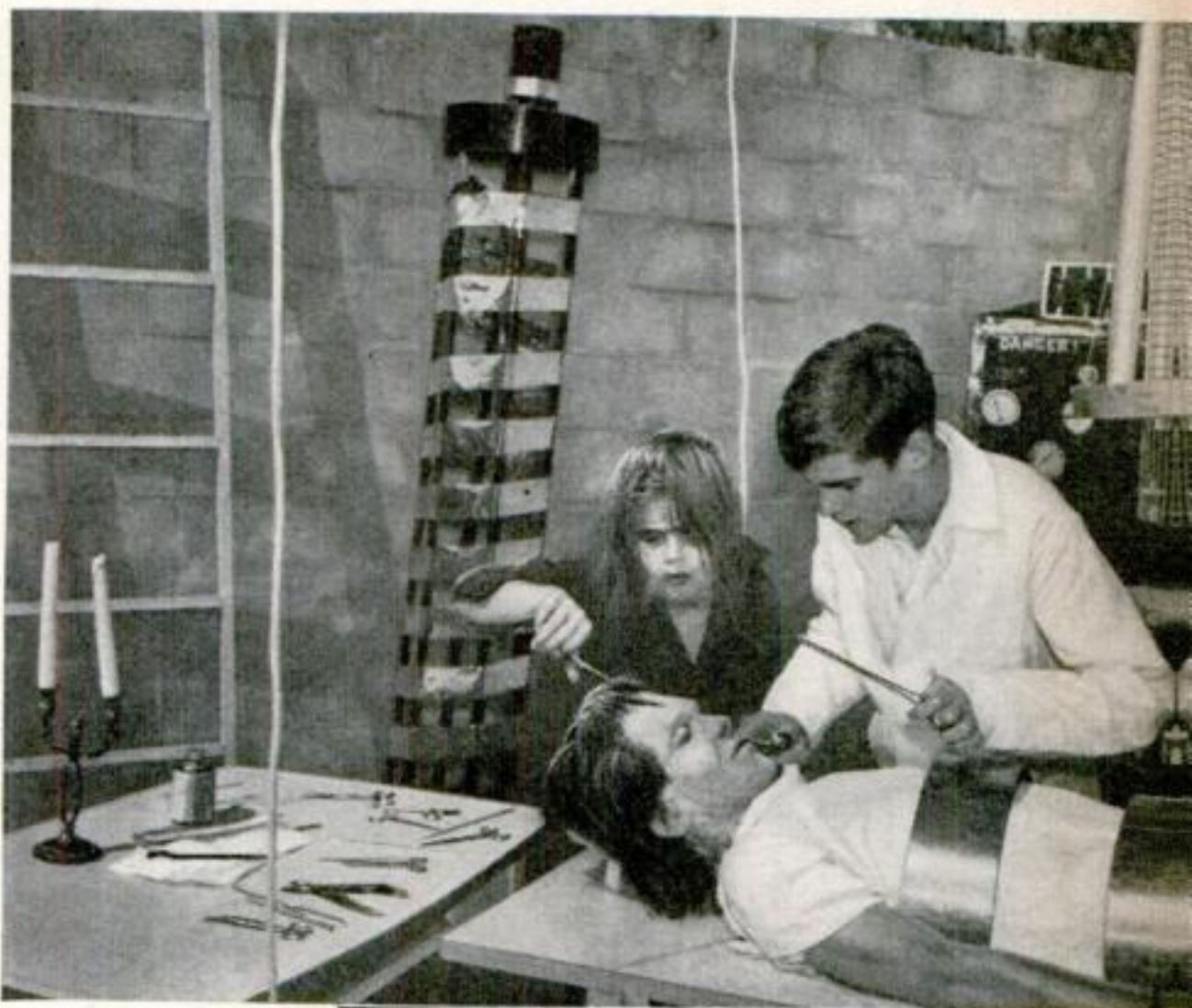


Members of the art department at work on posters. They also design and build sets

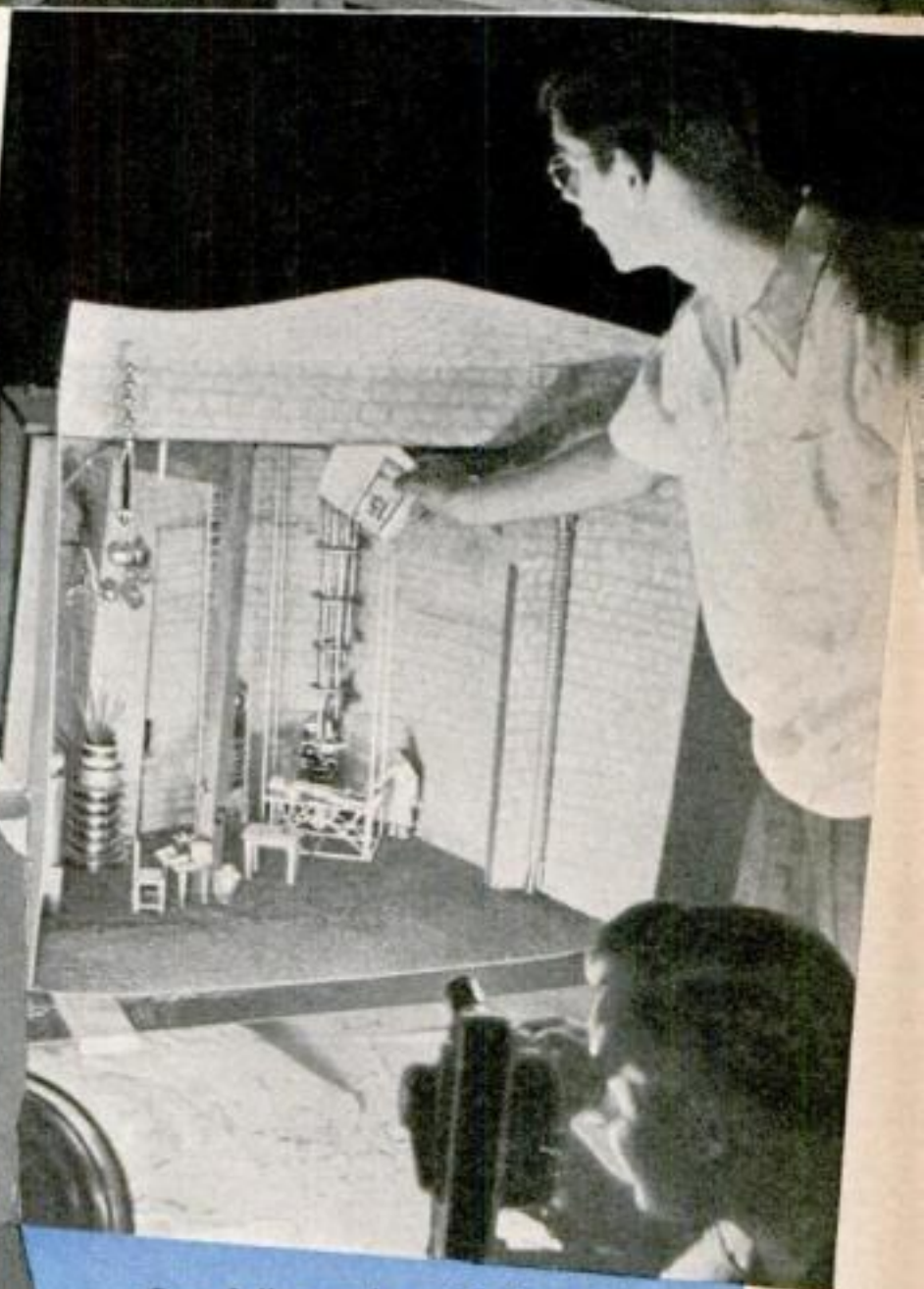


Amateur Movie Studio

share. Staffed by a complete set of department heads charged with handling properties, music, sound effects, scenery, costumes, make-up, publicity, and other phases of the work, the organization is run on a strictly businesslike basis, even to the issuance of individual contracts to the stars, minor players, and extras, who are selected by the company casting bureau from a list of over 300 prospects. Sound for the movies is recorded on wax disks, which are run off to synchronize, as far as possible, with the projection of the film. The company also produces newsreels of local events to run along with the showing of the major productions.



A dramatic scene in "Frankenstein." The young scientist is putting final touches on the monster that he has created. Note the make-up



Carefully made miniature sets, like the one above, are used in filming complicated scenes

Photo-Reproduction Typewriter

TO MAKE it easier to get perfect reproductions of typewritten material by the photo-offset process, in which the copy must be photographed, one manufacturer now offers an electric typewriter made specially for the purpose. Provided with an auxiliary carbon ribbon, the new machine produces deep-black typing that is said to reproduce without loss of color or quality. By moving a small lever, a regulation ribbon can be brought into use for regular office use.



This machine produces deep-black typing that photographs clearly

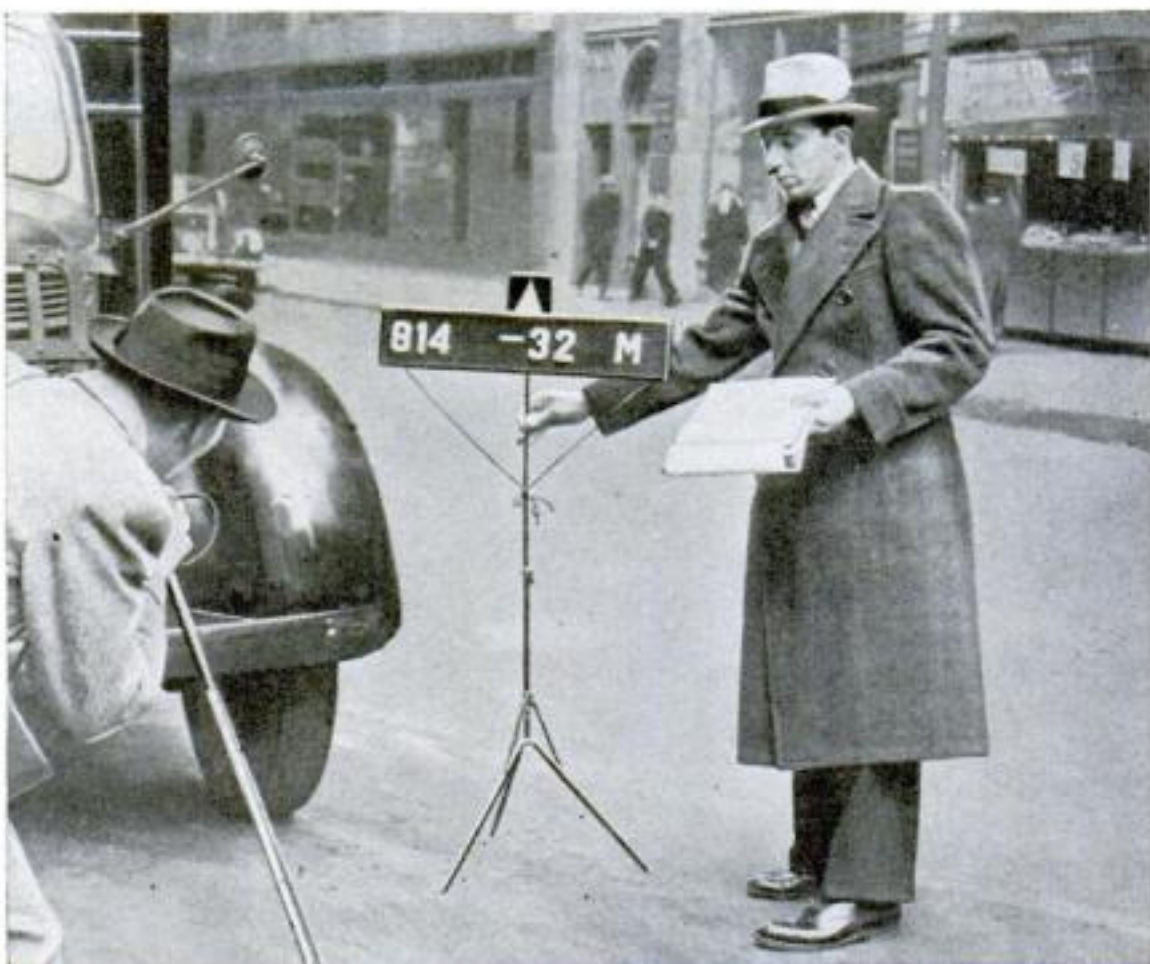


Floodlighting Headgear Leaves the Hands Free

BECAUSE she likes to have her hands free to operate her miniature camera, Mrs. Katherine Keeler, a Chicago, Ill., photography fan, rigged up the novel floodlight headgear shown in the picture at the left. It consists of three regulation reflectors rigged together with swivel clamps. One reflector is worn helmet-fashion, while the two others hold photoflood bulbs. A strap under her chin fastens the improvised headgear in place. Mrs. Keeler is known for her work in identifying handwriting.

Assessors Turn to the Camera for Tax Records

NEW YORK CITY'S Department of Taxation and Assessments has enlisted cameras to help keep its files of descriptions of the city's buildings. Using miniature cameras of the 35-mm. variety, two-man crews tour the city photographing buildings, identifying each with a numbered chart which is placed in the camera's range. Enlargements of the photographs are made and attached to the file records. A crew can make from sixty to 110 pictures a day.



A two-man camera crew snapping city buildings for taxation files

Author Keeps a Graveyard for His Characters



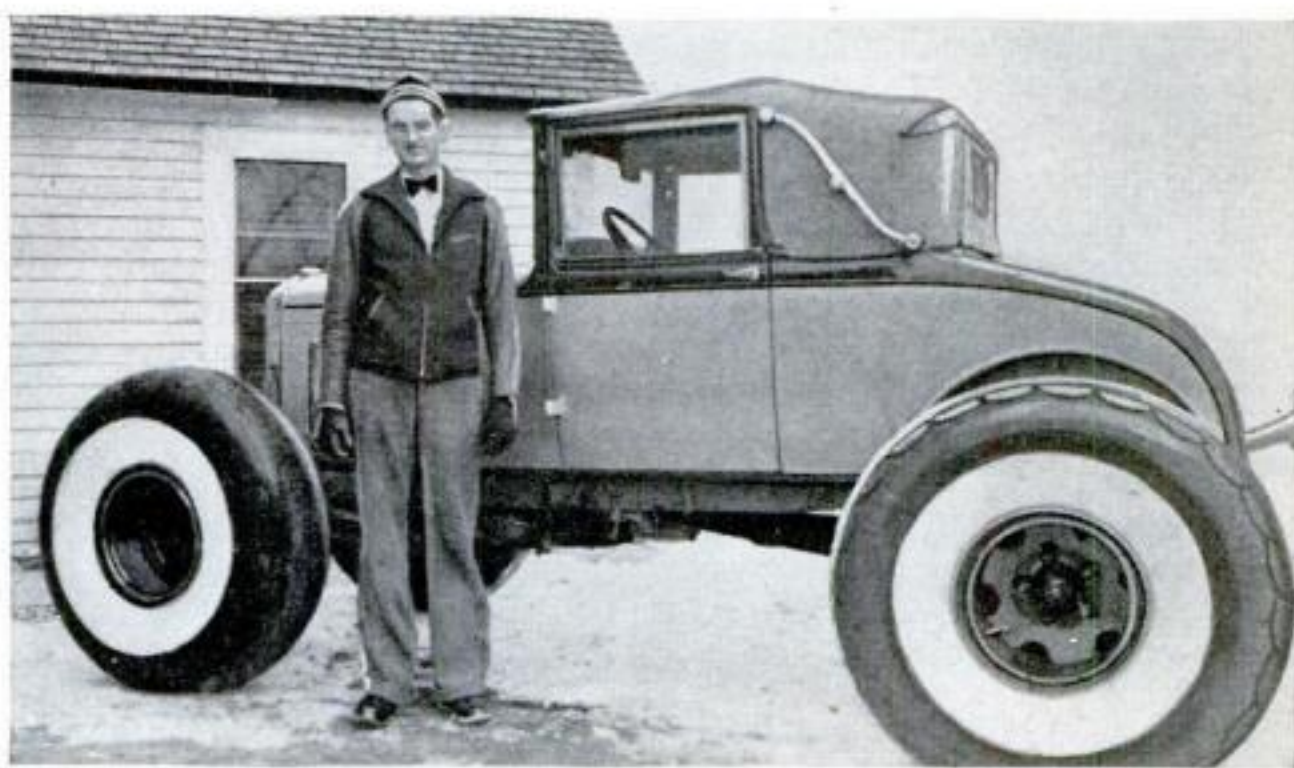
Sentimental attachment for the characters of his own fiction stories led Charles Martin, at work above, to establish this graveyard where those who "died" in his yarns could be buried

CHARLES MORRIS MARTIN, fiction writer, murders people right and left—in his stories. In addition, some of his characters die natural deaths. The sum total is an impressive number of fictional ca-

davers. Martin, whose specialty is gangster, detective and wild-west stories, has set aside a cemetery on his Oceanside, Calif., ranch where the "victims" of his stories may rest in peace, each with a mounded grave, and a headstone telling the character's name and the date of his demise.

Mud Buggy Helps Postman Deliver Mail

WHEN roads on the rural route of David Giddings, mail carrier of Fort Pierre, S. Dak., become impassable to ordinary motor travel because of mud, Giddings just climbs into his special coupe mounted on what appear to be overstuffed tires, and takes even the worst of the muddy highways and byways in stride. The car has a truck-type rear end, and forty-four inch transport-plane tires.



Where other cars get stuck, this postman's car goes smoothly along

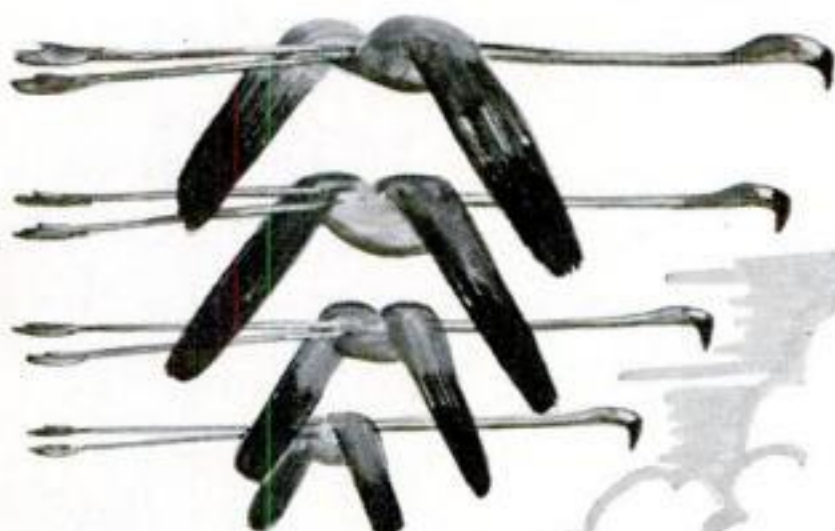
POPULAR SCIENCE *Question Bee*

You ought to be able to pick the right answers for at least sixteen of the twenty questions below. Make a note of your choice in each case, and check them against the list on page 213



- 1 You have received a blow on your tibia if you (a) stub your toe (b) strike your funny bone (c) bark your shin (d) bruise your knuckle.
- 2 An implement for drawing a wire taut is called a (a) coherer (b) anticline (c) turnbuckle (d) wheel puller.
- 3 The new frequency-modulation system for radio is intended to eliminate (a) electric shocks (b) static (c) aerials.
- 4 Circular mills are (a) places where logs are sliced into boards (b) units expressing the cross-sectional area of wires (c) coins worth one tenth of a cent apiece.
- 5 "Seventeen-year locusts" may be seen every year, because (a) earthworms drive them from their burrows (b) a different brood comes to the surface each year (c) it is a pure myth that any of them stay underground for seventeen years.
- 6 Intravenous injections are made in (a) dried-up oil wells (b) Diesel engines (c) the blood (d) stainless steel.
- 7 The most efficient of the following electrical appliances is the (a) motor (b) generator (c) lamp bulb (d) transformer.
- 8 In both the English and metric systems, you would measure (a) weight in pounds (b) length in feet (c) time in seconds (d) liquid volume in quarts.
- 9 "Gram-positive" designates (a) an early electric cell (b) certain kinds of bacteria (c) a substance that will float in water.
- 10 If you wanted to bore a hole in a board, you would pick up a brace and insert a bit in its (a) chuck (b) tang (c) jig (d) muzzle.
- 11 A chemist will tell you that ordinary gasoline is (a) an element (b) a compound (c) a mixture of a number of compounds.
- 12 Radio waves most nearly resemble (a) light waves (b) sound waves (c) ocean waves (d) heat waves.
- 13 When salt dissolves in water, the salt is called the (a) solute (b) solvent (c) solution.
- 14 If an animal conducts most of its activities in the daytime, its habits are said to be (a) diurnal (b) nocturnal (c) communal (d) vernal.
- 15 The rate at which a pendulum swings depends upon (a) its weight (b) its length (c) the material of which it is made.
- 16 Part of your brain is called the (a) erratum (b) vinculum (c) cerebrum (d) compendium.
- 17 If anything is annular, it is shaped like (a) a cross (b) an egg (c) a tear-drop (d) a ring (e) a figure 8.
- 18 Statistics of recent years show an increasing proportion of deaths from heart disease and other "old age" ailments, indicating that (a) they are taking on a more virulent form (b) the skill of doctors in treating them is decreasing (c) great progress has been made in prevention and cure of other diseases.
- 19 An object weighs most (a) high above the earth (b) at the earth's surface (c) deep below the earth.
- 20 "C.P." on a chemical label stands for (a) caustic potash (b) crude petroleum (c) corrosive poison (d) chemically pure (e) crystalline precipitate (f) colloidal preparation.

Un-Natural History *By Gus Mager*

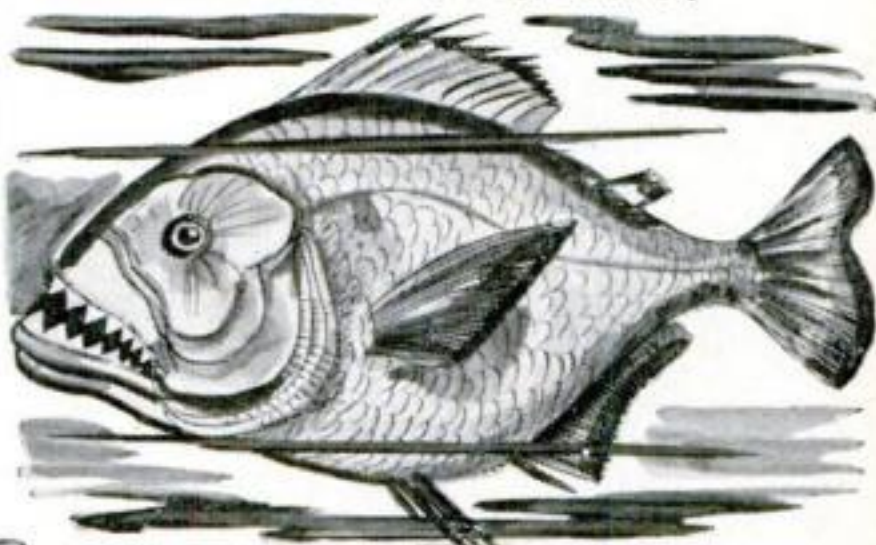


FLAMINGOS IN FLIGHT STRETCH THEIR LONG NECKS AND SPINDLY LEGS IN A STRAIGHT LINE FRONT AND BACK! FLOCKS OF THE STRANGE BIRDS FLAP THEIR WINGS IN UNISON!

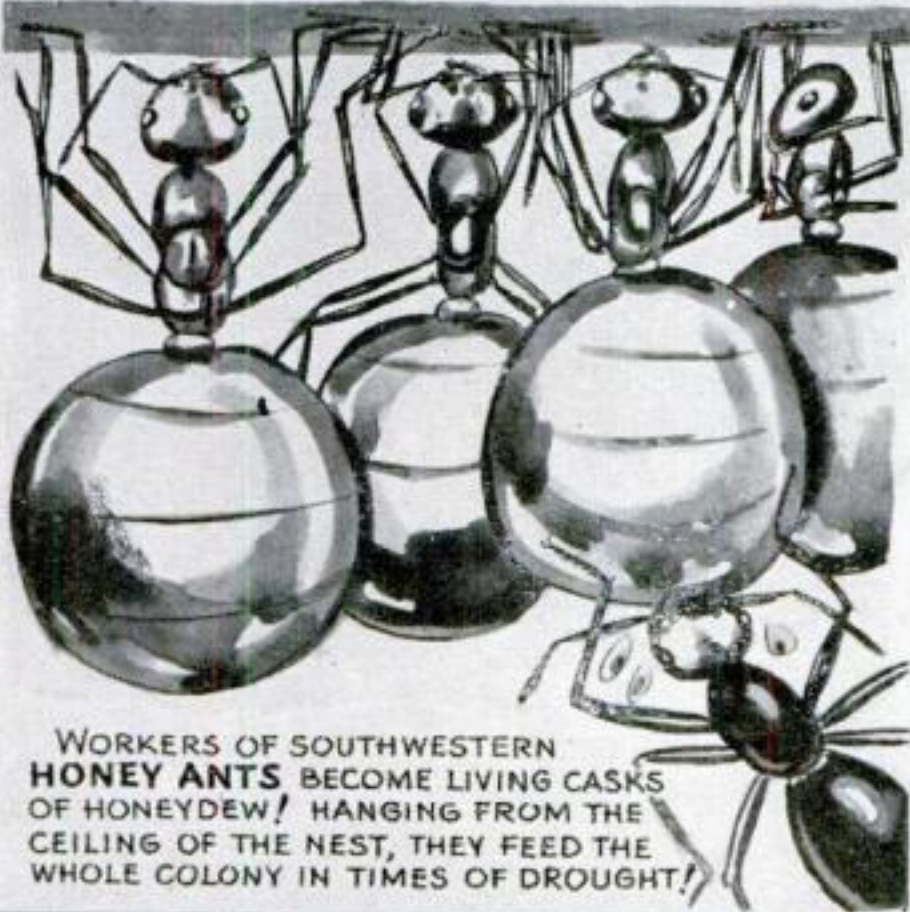
YELLOW ANTS IN THE SWISS MOUNTAINS ALWAYS BUILD THEIR NESTS RUNNING FROM EAST TO WEST! MOUNTAINEERS LOST IN FOGS USE THE NESTS AS COMPASSES!



THE POWERFUL JAWS AND RAZOR-SHARP TEETH OF THE **CARIBE**, MAN-EATING FISH OF SOUTH AMERICA, FORM A CONTINUOUS PLATE THAT CAN SHEAR THROUGH WIRE AND SMALL CHAINS!



WORKERS OF SOUTHWESTERN **HONEY ANTS** BECOME LIVING CASKS OF HONEYDEW! HANGING FROM THE CEILING OF THE NEST, THEY FEED THE WHOLE COLONY IN TIMES OF DROUGHT!



OUR **RED BAT** HAS FOUR TEATS! MOST BATS HAVE ONLY TWO!



IN DRY WEATHER THE **LEPIDOSIREN**, STRANGE RIVER FISH OF SOUTH AMERICA, CRAWLS OUT ON THE LAND WITH ITS LEGLIKE FINS TO KILL RATS, SNAKES, AND EVEN CHICKENS!



House of Batteries Defies Destruction

FIVE THOUSAND discarded storage batteries formed the unusual material utilized to build the walls of a three-room house erected in San Antonio, Tex., by Joe Perrin, an employee of a local battery company. Built on a foundation of rock, the battery walls were laid like bricks and cemented together with mortar. When completed, the walls were covered both inside and out with half-inch chicken-wire netting, over which two coats of plaster were applied. The framework and reinforcing members of the house are made of wood. The builder states that the battery walls afford complete protection against weather, fire, rats, and termites.



Applying chicken wire, and left, stuccoing the storage-battery house



Grotesque Creature of Wood Is Product of Nature

A LONG-TAILED monkey, walking on stilts and wielding a cane, is probably as close as anyone can come to a description of the weird wood formation pictured in the photograph at the left. A freak created by the ravages of wind and weather, the curious wooden figure was discovered recently near Big Bear Lake in California. The wood is pine.



Hitching Post Gives Way to Itching Post

IF YOU'RE ever around Birmingham, Ala., and feel that you'd like to scratch your back, stop in at Marvin Branch's service station there. As part of his service to motorists, Branch has erected a back-scratching post equipped with notches at different levels for the convenience of men, women, children, and dogs, in descending order. It's not used much, Branch says, but it amuses customers.



More people laugh over it than use it. Still, it works

Radio, Light, Motor Ease Lawn Mowing

TRIMMING the lawn is no longer a dull chore to Dr. Calvin Gibson, of Oklahoma City, Okla., since he fitted his lawn mower with an electric motor, a flood light, and a radio. Now when he cuts the grass during the evening, the motor pushes the mower, the flood lamp lights the way, and the radio keeps him entertained. A 150-foot extension cord connects the mower with an electric outlet.

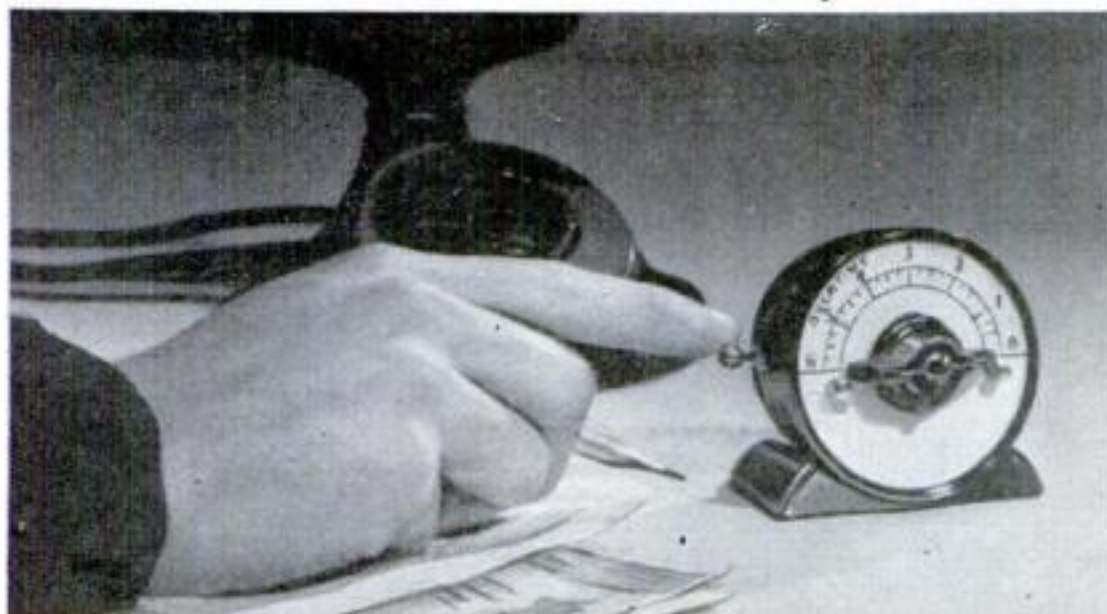
Mowing made fun: Powered by electricity, this mower also carries a headlight and a radio



Waterproof Garden Slacks

HOME gardeners need not fear damp or wet ground when working around their flowers and shrubs if they wear new gardening trousers made of fabrics specially impregnated with a synthetic rubber that renders them waterproof.

Touch Starts Telephone Toll-Call Timer



Twenty seconds before your three minutes are up, a bell rings

CALLS are timed automatically for telephone users by a mechanical device now available. When making a long-distance call, for example, the telephone user flips a lever on the device as his conversation starts, and a moving hand on a dial marks the elapsed time. Twenty seconds before the three-minute long-distance time allowance expires, the timer rings a bell, giving sufficient notice so that the caller can close his conversation.

New Appliances



STREAMLINE MILK BOTTLE. Designed to fit easily in a refrigerator, the new-style milk bottle seen at left, above, weighs less than the usual type

BOUDOIR CHAIR
Arranged as shown at the right, this novel chair makes a comfortable seat for use at the dressing table. By folding down the back, as below, it is made into an ottoman



LAMP-SHADE GRIP
Shades are anchored firmly to indirect-lighting lamps with molded-rubber grips. Slots hold wires on rim of reflector bowl



CANDLE DRIP CATCHER. Moving down as the candle burns, a "follower" of heat-resisting glass, at left, catches the melted wax



SOAP DISH FOR SHOWER
A specially designed suction cup holds the plastic soap dish below on a shower wall or tub



for the Household



FLUORESCENT KITCHEN LIGHT
Chemicals that glow furnish modern illumination for a kitchen in the compact, easily installed electric unit shown above



MINIATURE IRONING BOARD. Resembling a rolling pin sliced in half, this midget ironing board is handy for pressing the sleeves of garments

RAIN-ALARM BELL
Placed on the sill of a window, the bell at right wakens a sleeper if rain comes in. A paper strip breaks to release the spring



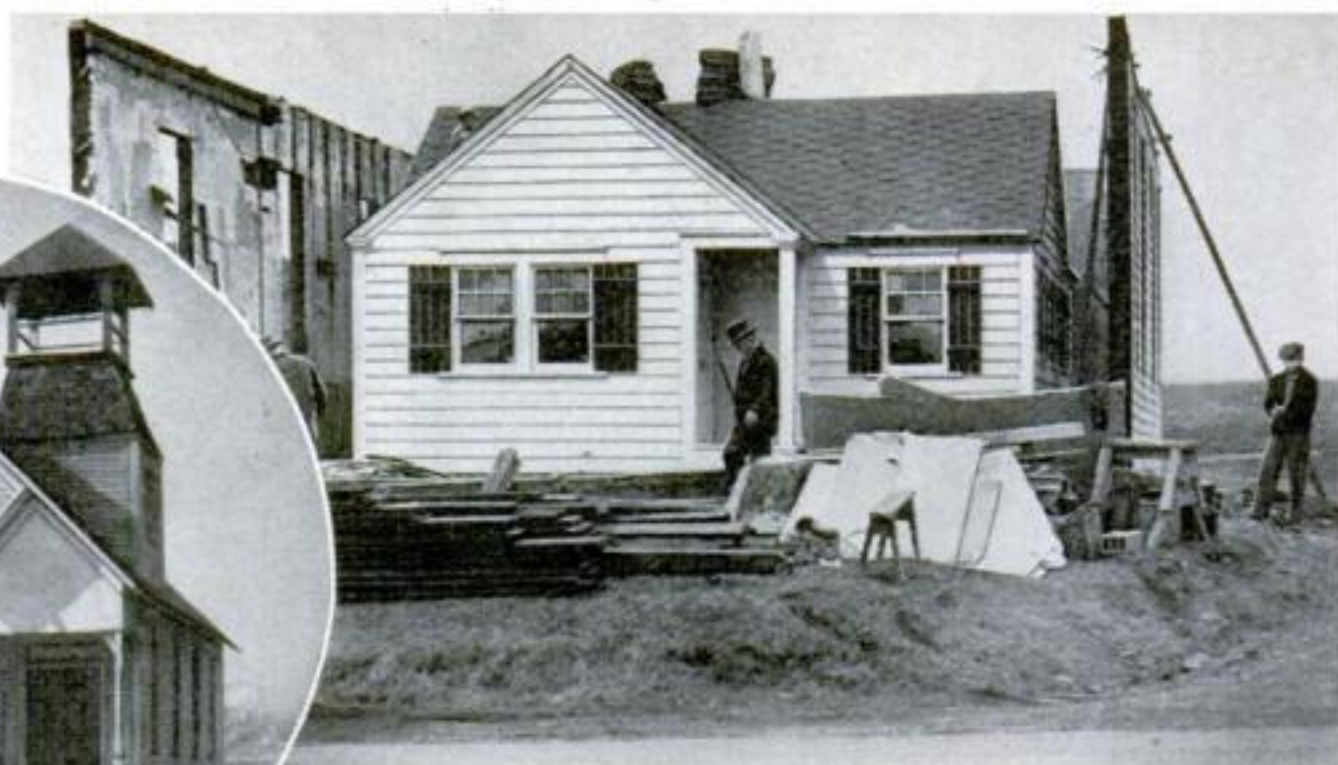
TEAPOT CLOCK
It's always tea time by a novel electric clock shown at the left, designed for use in the kitchen or dining room. The metal case is shaped like a small teapot



AUTOMATIC BLINDS

Cords are eliminated on the new Venetian blind shown by Irene Rich, radio star. A spring, controlled by a button, adjusts it like an ordinary shade

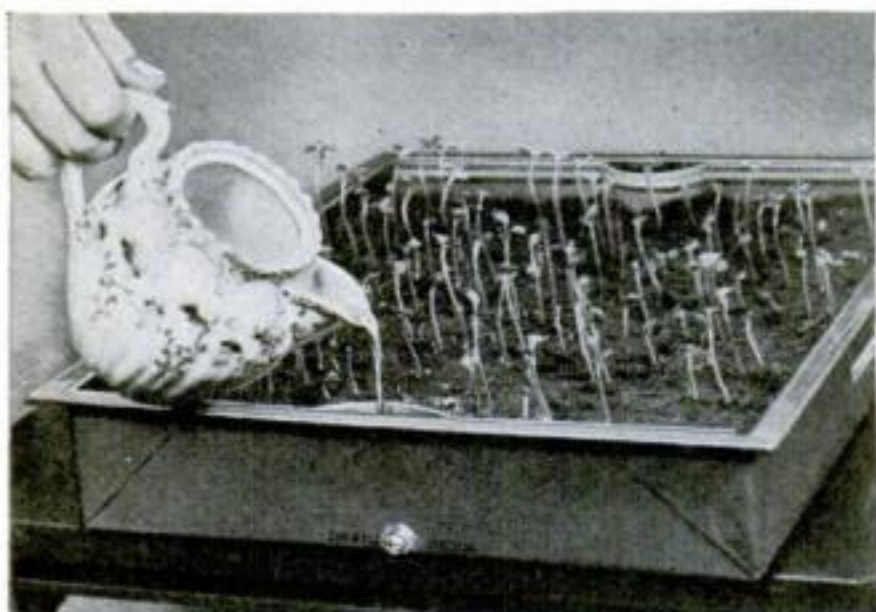
After the five-room bungalow was completed the church was torn down by the builder



Church Keeps Builder Warm As He Puts Up Bungalow

BUILDING a bungalow inside of an old church, and then tearing down the church, is the novel way that William Provens, of Manchester, Ohio, outwitted cold winter weather and got his home finished by the time warmer weather arrived. Provens, a builder by profession, started the

foundation for his house in January. Protected from winter winds by the walls of the abandoned church, he was able to complete and paint his new home by early summer. Then he tore down the church walls, and the finished bungalow emerged like a butterfly from its cocoon.

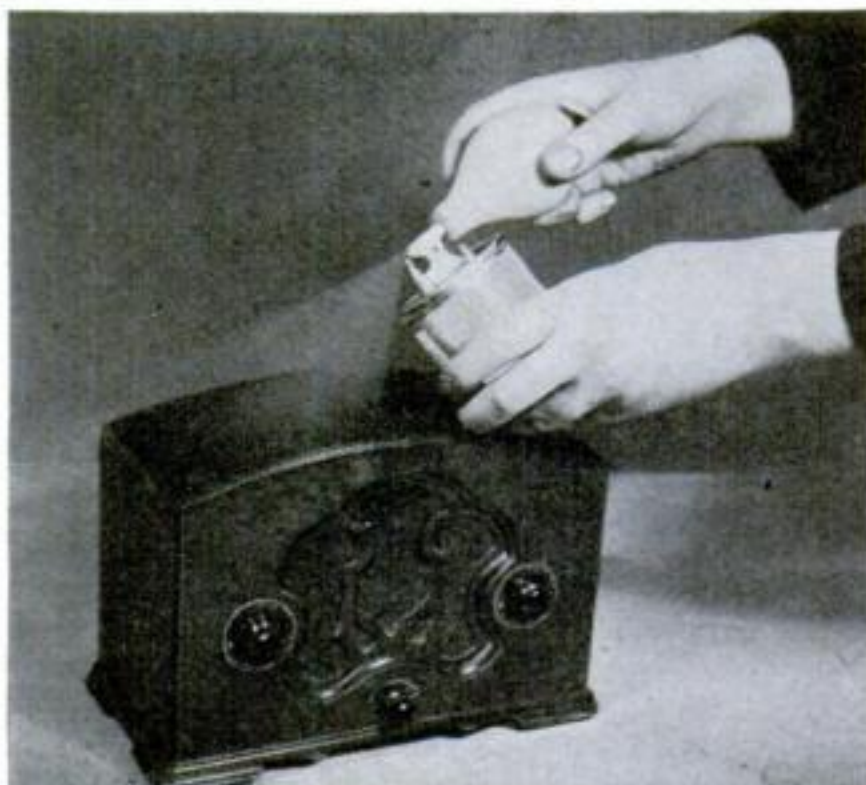


Paint Cans Now Equipped with Own Spray Guns

BUILT into the top of a standard-size can of paint, a novel bulb-type spray gun makes it easy to touch up or repaint small objects around the home. Squeezing the bulb forces out quick-drying paint in a fine spray that will adhere to any baked-enamel or plastic surface.

Seed Flat Made of Metal Irrigates from Below

A DURABLE, all-metal flat for growing seeds in the home or in cold frames or hot-houses, is fitted with a corrugated and perforated inner tank that rests on the bottom, so that seeds may be irrigated from below and not disturbed by watering from above. The tank walls are shaped at the ends to form openings down which water is poured. Moisture then seeps up through the soil to the surface. Excess water may be drained off through a plug.



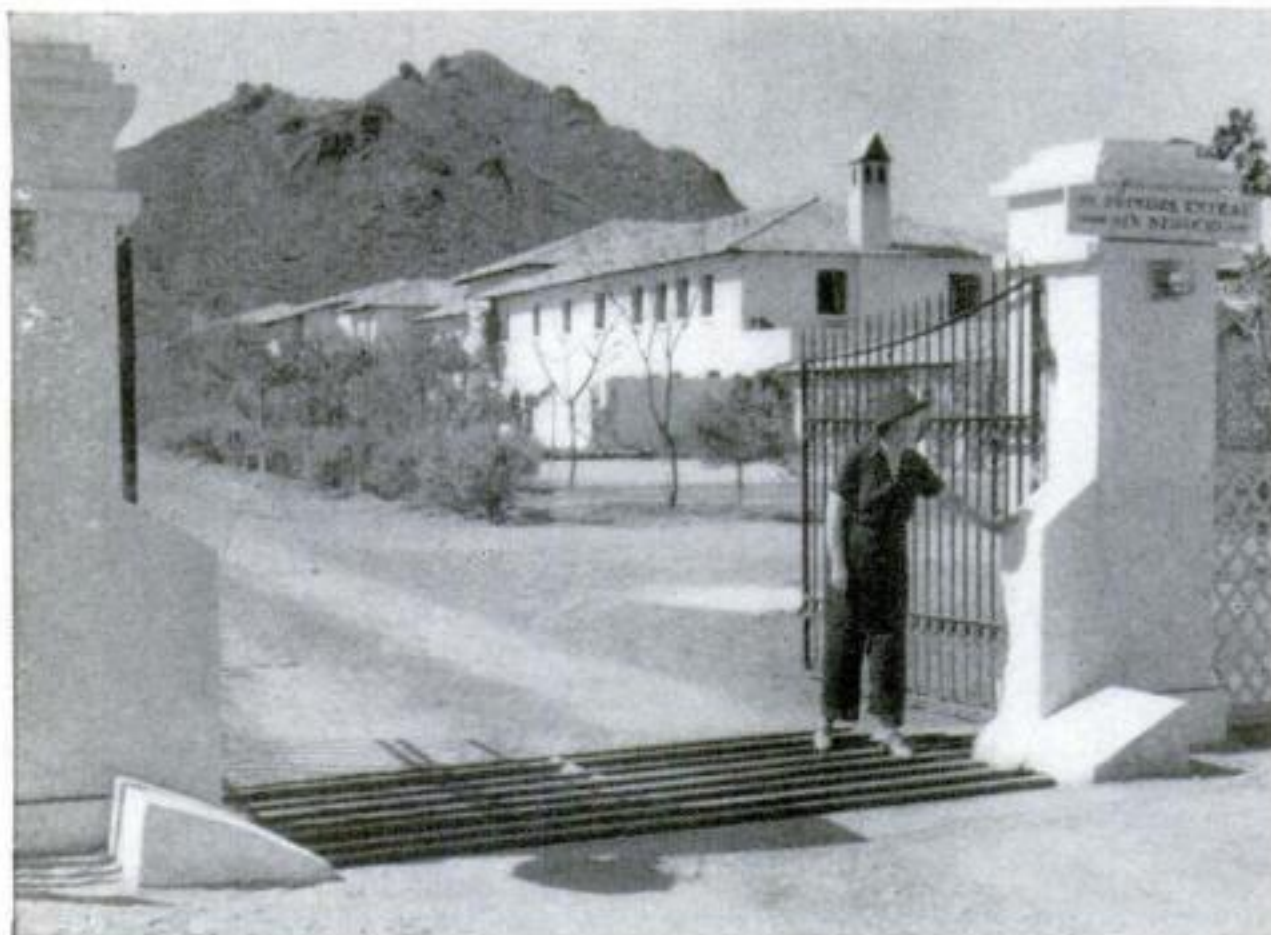


How Long Does It Take To Paint a House?

If you want your house painted right away, and expense means nothing, you can have the whole job done, including the trim, in exactly four minutes and fourteen seconds. At least that's the amazing record claimed by 110 expert painters who tackled a nine-room house in Omaha, Neb.

The new mark is less than half the previous time of eight minutes and thirty seconds made when a team of Tennessee brush wielders swarmed over a similar dwelling in Memphis. The photograph above shows nineteen of the painting Nebraskans. Can you find them all?

Sunken Rails Serve as Cattle Gate



Cattle refuse to enter this gate, but it is no barrier to cars or people

BECAUSE of its location in the middle of cattle-grazing country, a Mexican resort hotel erected sturdy fences to keep cattle from wandering into the hotel grounds to graze on the lawns, flower beds, and shrubbery. To eliminate the necessity of opening and closing gates in the fence every time a motor vehicle entered or left the grounds, railroad rails were placed in the roadway between the concrete entrance gateposts. Although not barring automobiles, trucks, or pedestrians, the rails effectively discourage cattle from entering.

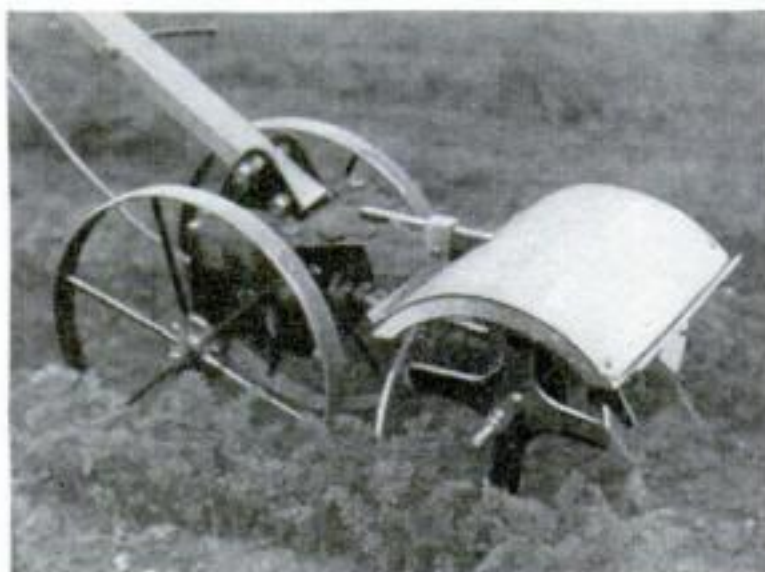


Water Gauge for House Plants

MAINTAINING the correct degree of moisture in soil in which house plants or seedlings are growing is made easy by a small gauge just introduced. A strip of chamois in a perforated aluminum prong that is pushed into the soil contracts or expands according to the moisture present. Condition of the soil is indicated on a small dial at the top.

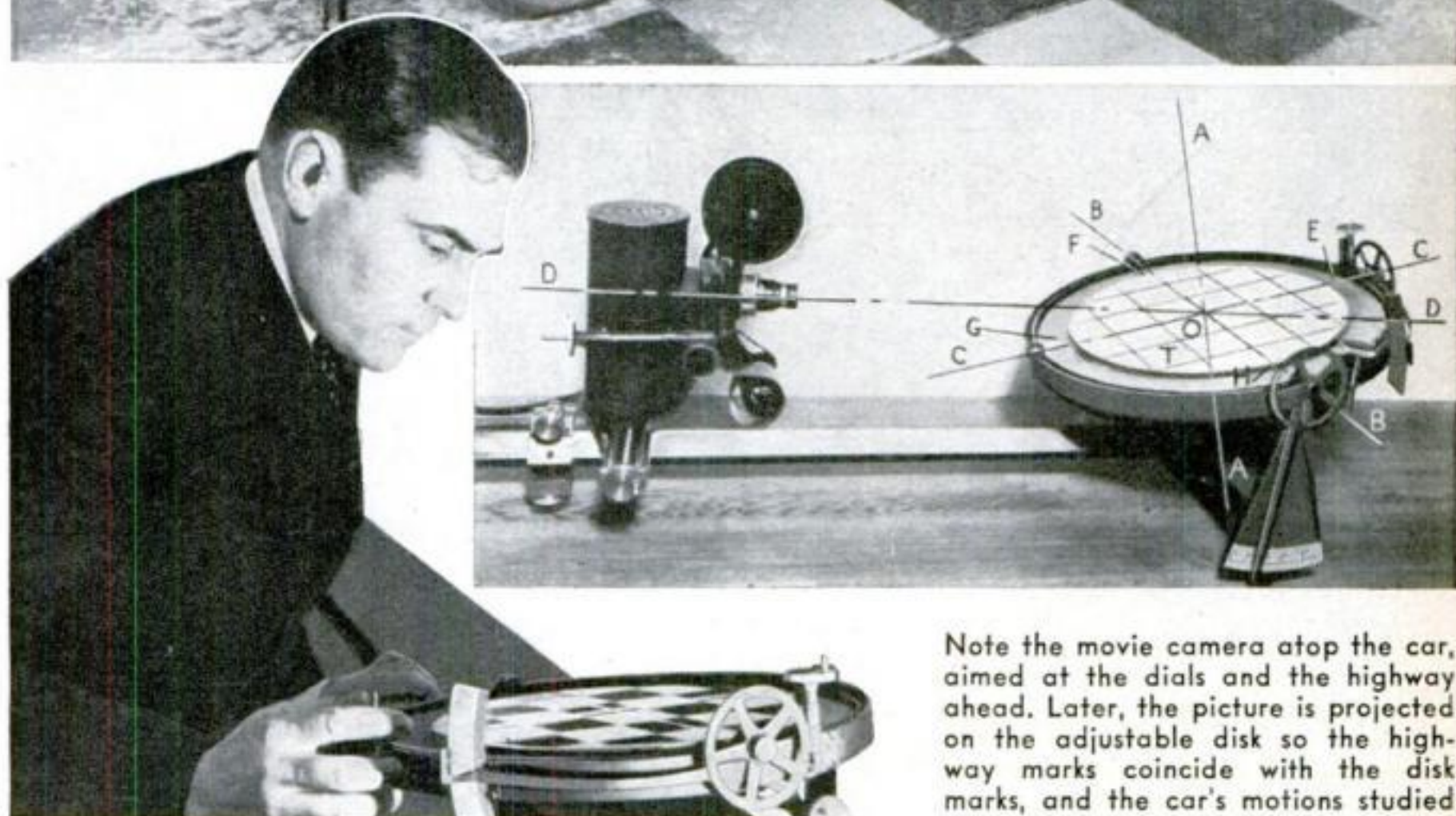
Electricity Powers Garden Hoe

GARDEN hoeing can be done by electricity with the powered hoe pictured in the photograph below. Guided by hand, the farming tool is operated by an electric motor mounted between two metal wheels. A shaft about eight inches long leads forward to an axle around which hoe blades revolve. Power is drawn from an electric outlet by means of a long extension cord. Gardeners who have tested the power tool say that it is specially useful for working in close to plants without injuring them.



A long extension cord supplies current to the hoeing machine. Note motor between the wheels





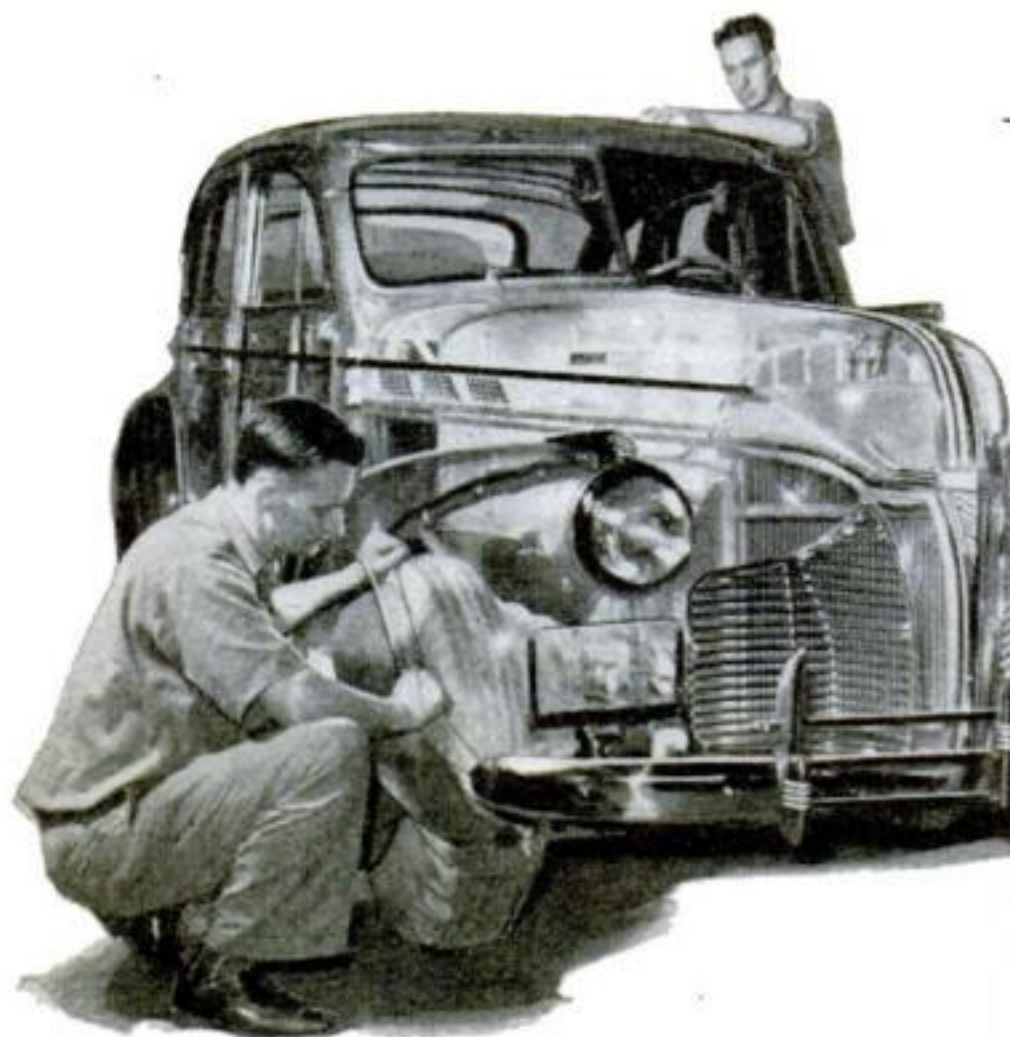
Note the movie camera atop the car, aimed at the dials and the highway ahead. Later, the picture is projected on the adjustable disk so the highway marks coincide with the disk marks, and the car's motions studied

Movies Help Build Better Cars

WHAT actually happens to the steering-wheel linkage, axle bearings, springs, wheels, and other undercarriage mechanisms when your car streaks down a highway at eighty miles an hour? These and other problems—engineers call them by such terms as attitude, slip, wind drift, pitch, and axle displacement—all concerned with good steering, are answered accurately for the first time by an analyzer developed at the General Motors Proving Ground, at Milford, Mich. Four dials on a bracket over a car's front bumper are connected to

the steering wheel, front wheels, and rear axle, to show precisely the movement of the various parts as the car speeds down a test highway marked like a huge checkerboard. Atop the moving car's roof, a movie camera records the dials and the highway ahead. Later, the film is projected on a calibrated checkered disk. Then, the exact path the car took can be measured by adjusting the disk so that its checked pattern exactly coincides with the projected one of the highway, permitting comparison of the dial pictures with the actual car movements.

Plastic "X-Ray Body Shows Car's Innards



Expert craftsmen hand-finishing the molded plastic parts for the transparent car shown completely assembled in photo at left



DUPLICATING exactly the body lines of the newest 1940 models, two transparent automobiles have recently been completed by a leading motor-car manufacturer. The cars are the real thing in every sense of the word—except for their glass-like outer shells which provide an X-ray view of the chassis, motor, and other details of inner construction. Parts for the car bodies first were molded from sheet plastic and then carefully finished by hand, as shown in the accompanying photographs.

The completed cars, the only ones of the kind in the world, have been placed on exhibit at the New York World's Fair and the Golden Gate International Exposition.

Handy Magnifier Aids Motor Inspection



The magnifier shines a light on the object to be viewed

DESIGNED specially for examining valves and valve seats in automobile motors, the illuminated magnifier shown in use in the illustration at the left is also handy for inspecting other out-of-the-way parts in and around cars. A tiny lamp fitted in the base of the viewer, which is available for use either with dry cells or house current, shines on a field directly beneath a powerful magnifying lens. Held over a surface to be examined, the magnifier clearly reveals minute flaws in material or defects in workmanship which would escape the unaided eye. It is made of a strong molded plastic.



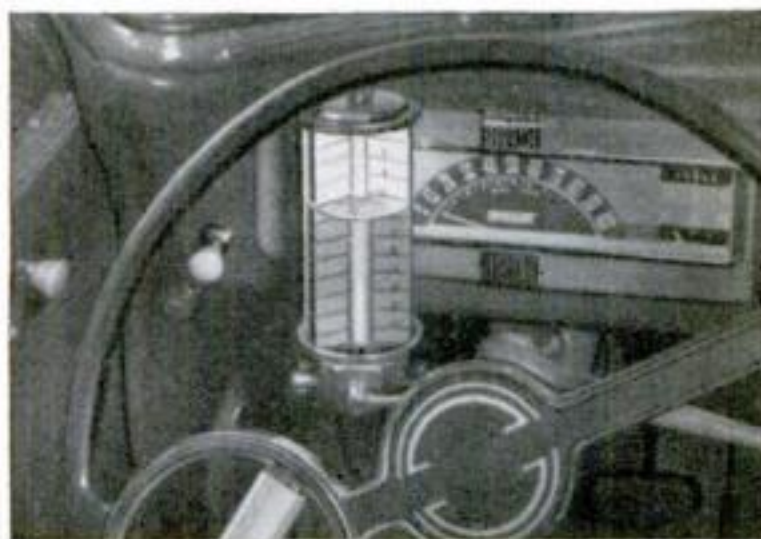
Even without reading them, you get the meaning of these novel signs

Queer Symbols Put Kick into Traffic Signs

A SNAIL, a worm, and a nurse are among the striking symbols attached to traffic signs recently installed in Avalon, on Santa Catalina Island, Calif. The snail tops the "Slow" marker, the worm adorns the "Curve" sign, and the white-capped nurse cautions "Hospital—Quiet."

Tester Shows Fuel Mileage

AT WHAT speed does your car use the least gasoline, in miles to the gallon? Attached to the dashboard close to the speedometer, a glass testing device just introduced holds one tenth of a gallon of gasoline and has a built-in scale marked off in hundredths of a gallon. When a petcock is turned, the car engine runs on gasoline drawn from the glass tank, so that the consumption can be visibly checked against mileage and speed readings of the speedometer and odometer without making bothersome measurements at the gas tank.



Mileage tester attached to car's dashboard

Police Run Car-Repair Service

OPERATED by New York State Police, emergency service trucks now cruise Long Island parkways to forestall traffic jams and accidents by rushing to the aid of cars stalled by blow-outs, motor trouble, or empty gasoline tanks.



A roadside cache for gasoline to be supplied car owners who allow tanks to run dry

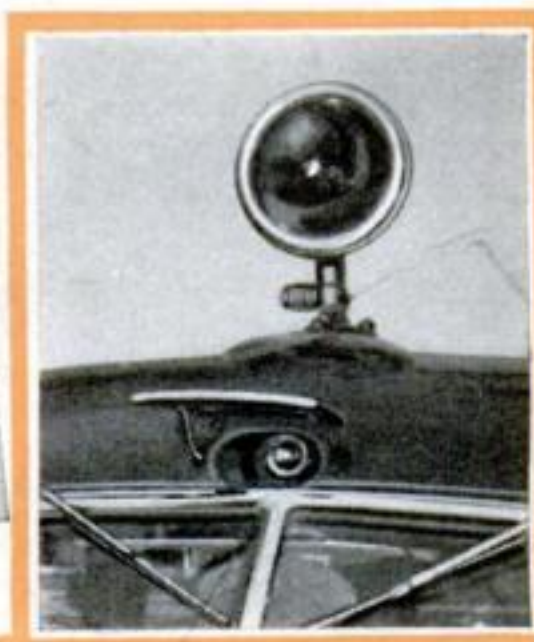


Emergency service keeps traffic moving on parkways

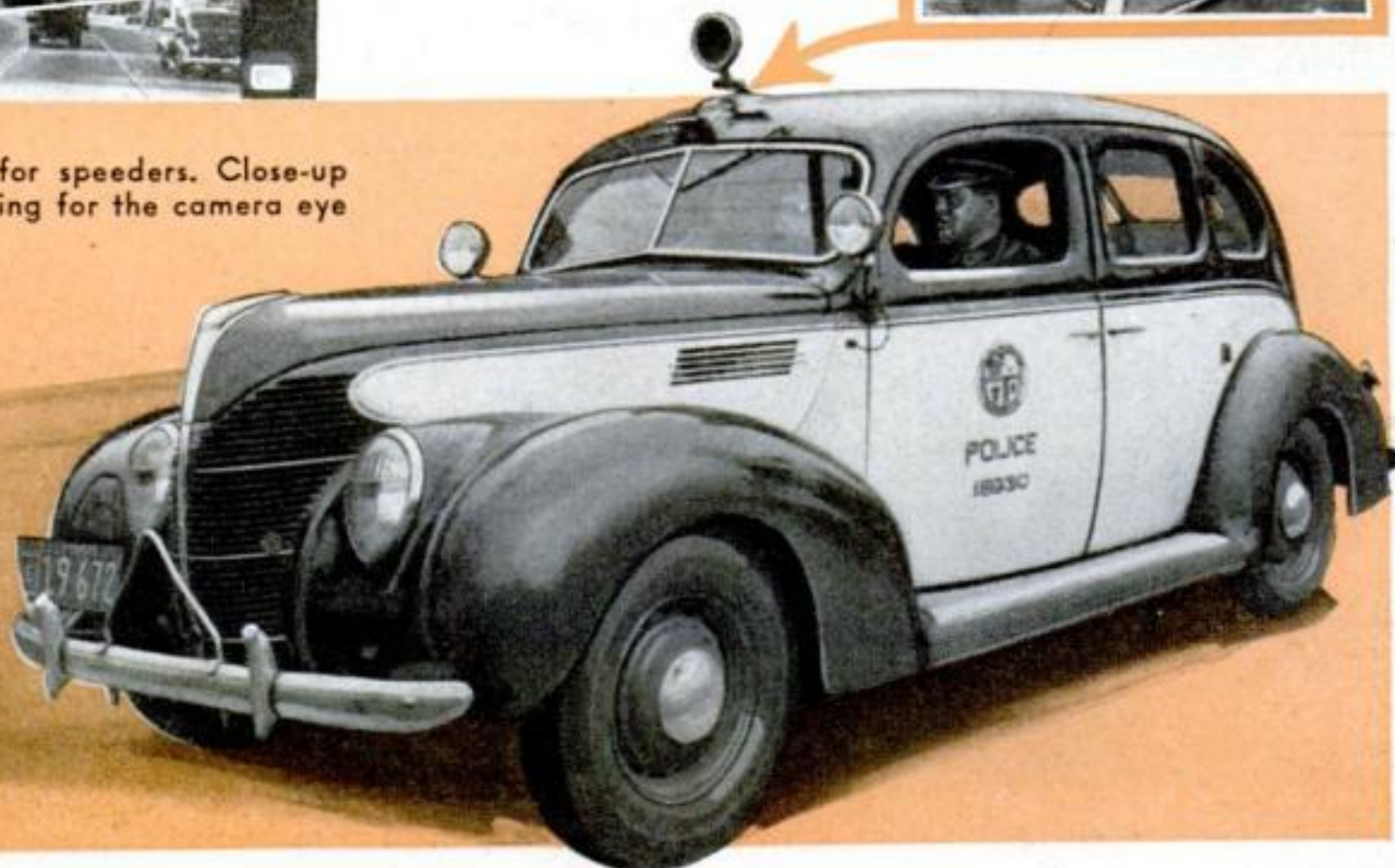
Police Cameras

POSITIVE proof of reckless driving, speeding, and other traffic violations is collected by a rolling movie studio and sound laboratory placed in service by the Los Angeles, Calif., police department. Aimed through a hole in the police-car roof, a movie camera is mounted above the driver. When following a traffic violator along the road, the police driver touches a button to start the camera, which records on film not only the position and maneuvers of the car being trailed, but also its speed, since prisms project an image of a special speedometer onto one corner of the camera film. When the traffic violator's car is overtaken and stopped, an officer approaches the motorist, concealing in his hand a small microphone

A camera set under the car roof takes movies of a vehicle ahead. In sample film strip, note the speedometer record



On watch for speeders. Close-up shows opening for the camera eye



Trap Reckless Drivers

from which a cable leads back to recording apparatus in the police automobile. Thus statements made by the law violator are recorded for later use as evidence. At night, special high-powered spot and flood lights which can be directed from within the cars provide sufficient illumination for the police cameras. The equipment carried by the officers includes still cameras as well as the movie apparatus.

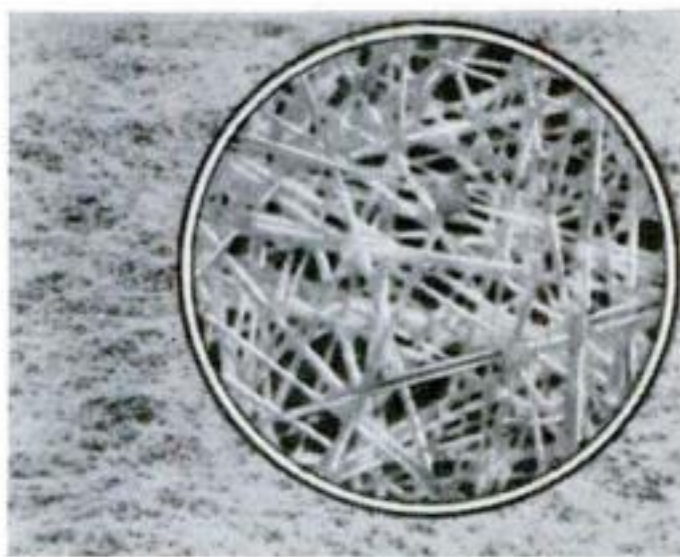


Through a microphone held by the officer, drivers' replies are recorded with the apparatus at left

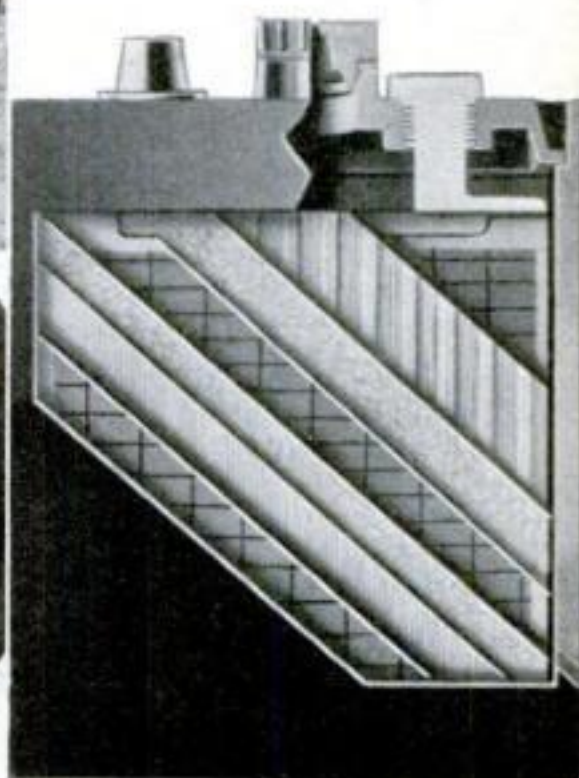
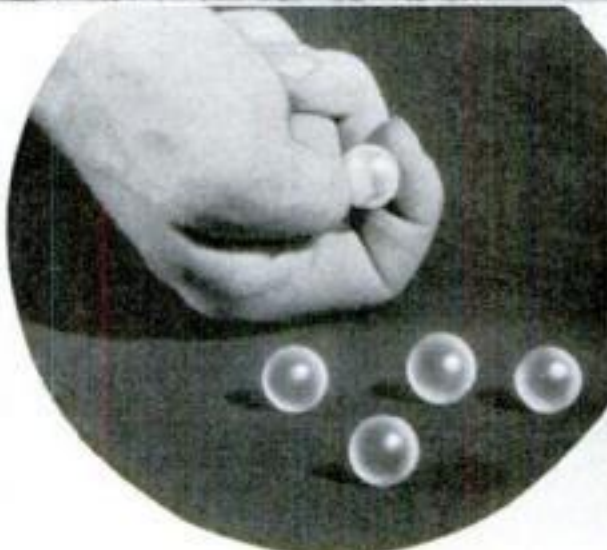


Marbles Yield Glass Mats for Batteries

MATS of acid-resisting fibrous glass, used as plate separators in a new type of storage battery, are said to double the life of the battery. Glass marbles are heated to a molten state, formed into flexible fibers, collected on a flat surface, and held together with an insoluble binding material. The porous material is then cut into mats of the desired shape, approximately one hundredth of an inch thick. Between 400 and 500 miles of tiny glass fibers are contained in one of the mats used in the new battery. The glass mats, as illustrated at the right, are installed between the positive plates and the cedar separators.



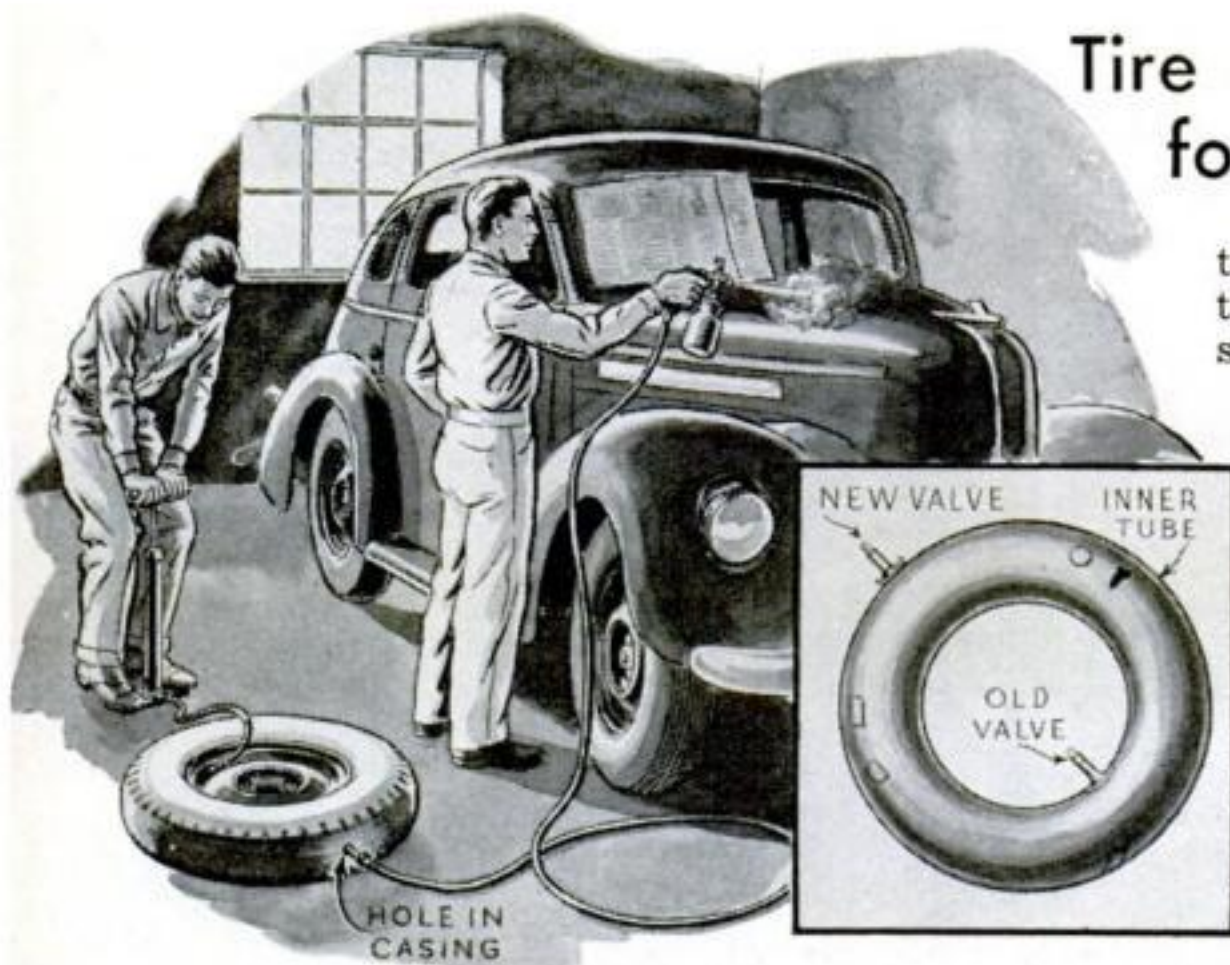
Spun-glass battery mat, partly magnified. Lower left, the raw material. Below, cut-away view of the new battery



Seven New Tips

Tire Compresses Air for Spray Gun

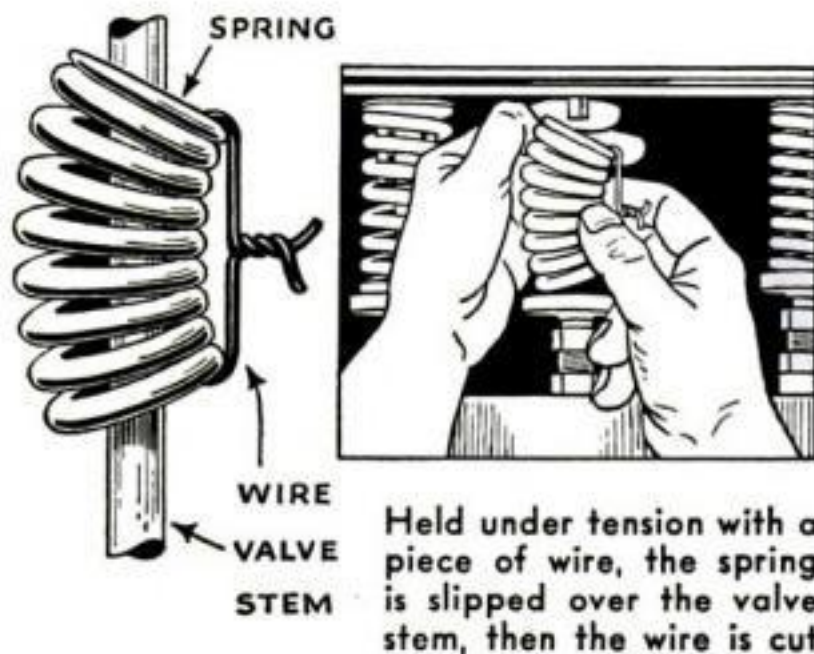
MAKE a hole in the top centers of an old inner tube and tire casing, and insert a valve stem minus its valve in the tube. Mount the tube and casing on a spare wheel. By connecting your spray gun to the new valve stem, and a tire pump to the old one, you've got an efficient compressor for paint-spray jobs on your car, or for other jobs for that matter. You can use an assistant, as in the illustration, or pump up a supply yourself and then go to work with the spray gun.—P. M.



How an old tire can serve as an air reservoir for your spray gun

Automobile Door Straps Safeguard Children

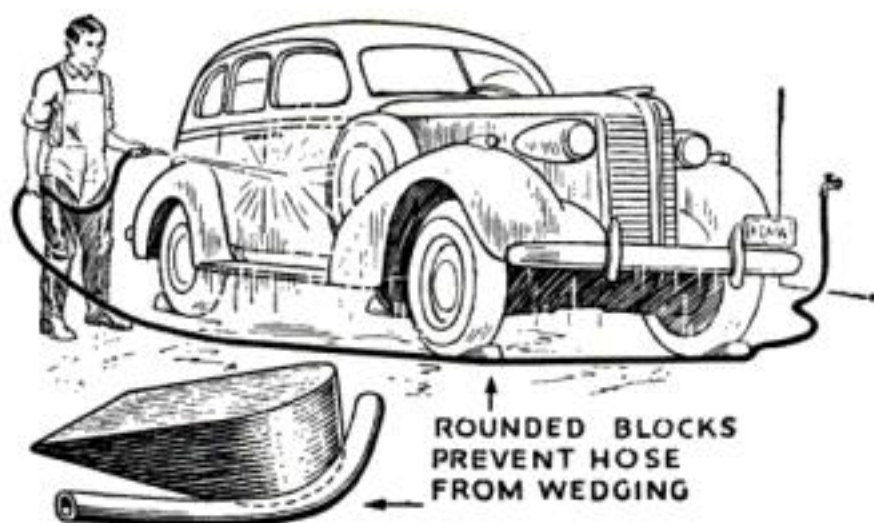
It's hard to keep youngsters in the back seat from opening the rear doors while a car is in motion. I solved the difficulty by fashioning a leather strap as shown in the sketches below. A hole at one end of the strap fits permanently over the door handle. To the other end of the strap a metal ring is securely sewed. A shorter section of strap fastened to the robe cord has a stiff snap hook which engages the ring to hold the door shut.—H. R.



Simple Way of Installing New Valve Springs

ON SOME cars, it is possible to install new valve springs without removing the cylinder head and the valves, thus saving time on the job. Cut away the old spring, then compress a new spring in a vise, being careful not to damage it. Run a wire through the spring and bring the ends around so that they may be twisted together to hold the spring when it is removed from the vise. The spring may now be worked under the raised valve stem and up into place, after which the holding wire can be cut and pulled out.—J. W. P.

for Car Owners



Wedges Keep Hose from Snagging Under Tires

UNTIL recently, every time I washed my car, I was annoyed by the way the water hose would catch underneath the wheels as I dragged it around the car. So I contrived the wedges, shown above, from a length of two-by-four lumber, rounding off the edges with a plane. Jamming one under each wheel keeps the hose from getting caught and saves a lot of time otherwise spent in disentangling it.—J. W. P.

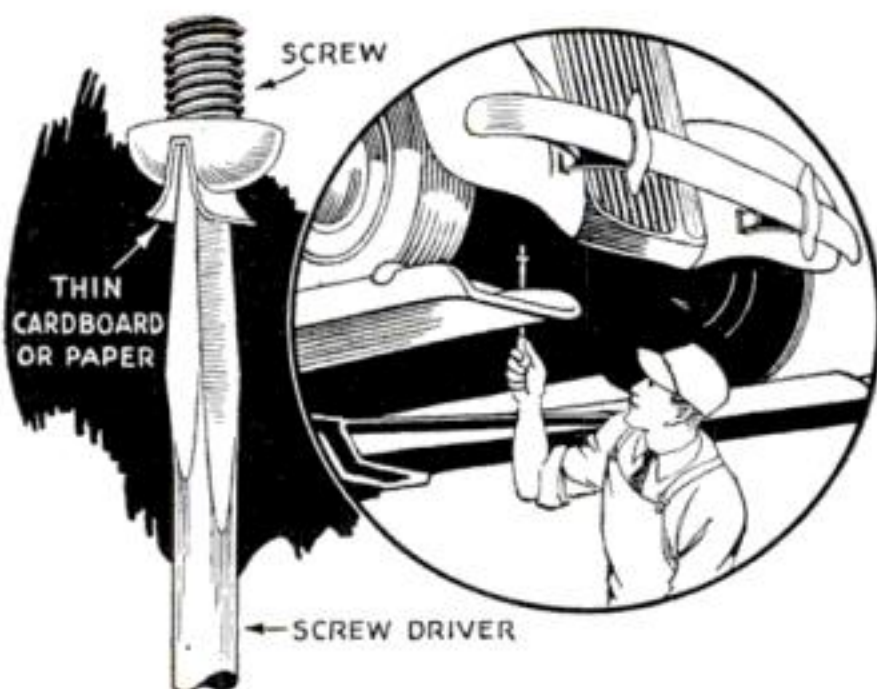


Insulation Cracks Filled with Finger-Nail Polish

COIL failure caused by a crack in the insulation around the high-voltage terminal, as indicated above, allowing the spark to short out on one of the low-voltage terminals, can be cured by the application of finger-nail polish of the lacquer type on the break. My car has run over a year with that "patch up."—A. W. G.

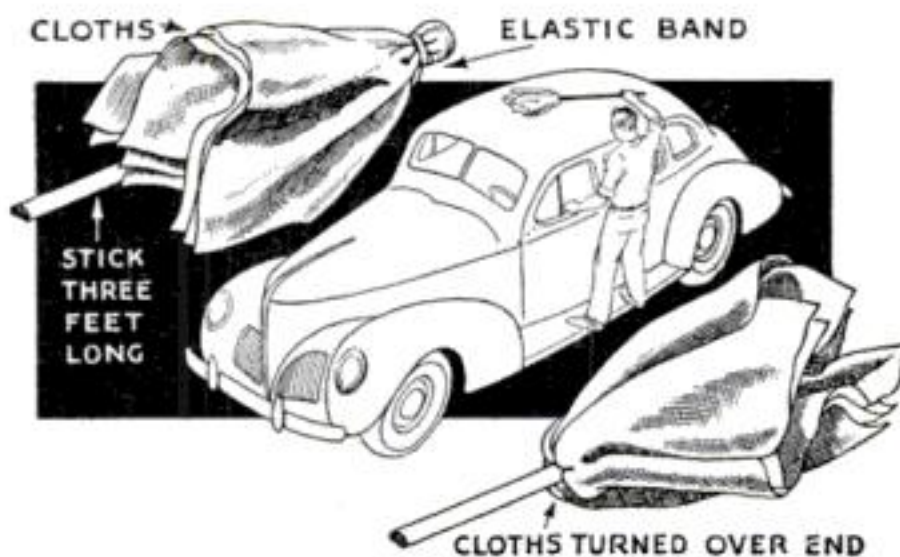
Paper Strip Holds Screw for Easy Starting

WHEN you have trouble starting a screw in an out-of-the-way place with an ordinary screw driver, try cutting a thin strip of cardboard or paper and bending it over the blade of the screw driver. The blade will then form a tight fit in the slot of the screw head so it can be started.—J. W. P.



Broom Handle and Cloth Make Car-Top Duster

TO MAKE a handy car-top duster, take a three-foot length of broom handle in which a groove is cut near one end. Over the same end place several dusting cloths two or three feet square. Bind them tightly in place with a heavy elastic band pressing them into the groove. Now turn the dust cloths back over the bound end of the stick and you've got a handy, scratchless top duster ready for use.—E. L. H.



Gus Keeps a

A GOOD CAR DOCTOR, LIKE AN M.D., NEVER DISCUSSES

"MY name's Pond, and I'm a peculiar sort of a cuss about noises," explained the little man who just had driven a well-kept sedan into the Model Garage shop. "I can't stand them. Specially noises in a car. This one's driving me nuts!"

Gus Wilson cocked his head and listened to the hum of the idling engine. Its smooth purr told him that it was a good engine which had been given good care. "Sounds fine to me," he said.

"Yes, it sounds fine—now!" Pond agreed. "But just wait! It runs for five or six minutes the way it ought to run, and then I hear that blamed noise. Listen!"

Gus listened. For another minute the engine continued its smooth hum. Then he heard it—*tap—tick—tick; tap—tick—tick*; a faint tapping and ticking sound that few drivers would have noticed.

"Yes, there's a noise—an unusual sort of noise," Gus said. "How long have you been hearing it?"

"Since yesterday," Pond told him. "Yesterday morning, down in the city, I took the car into one of those fancy service stations to have a little electrical job done on it. You know the sort of a place I mean—where a fellow in a white coat glad-hands you when you drive in, writes down what you tell him is the matter with your car on a form, and then hands the job over to some guy who doesn't do anything but brakes or transmission or something. Well, soon as I drove

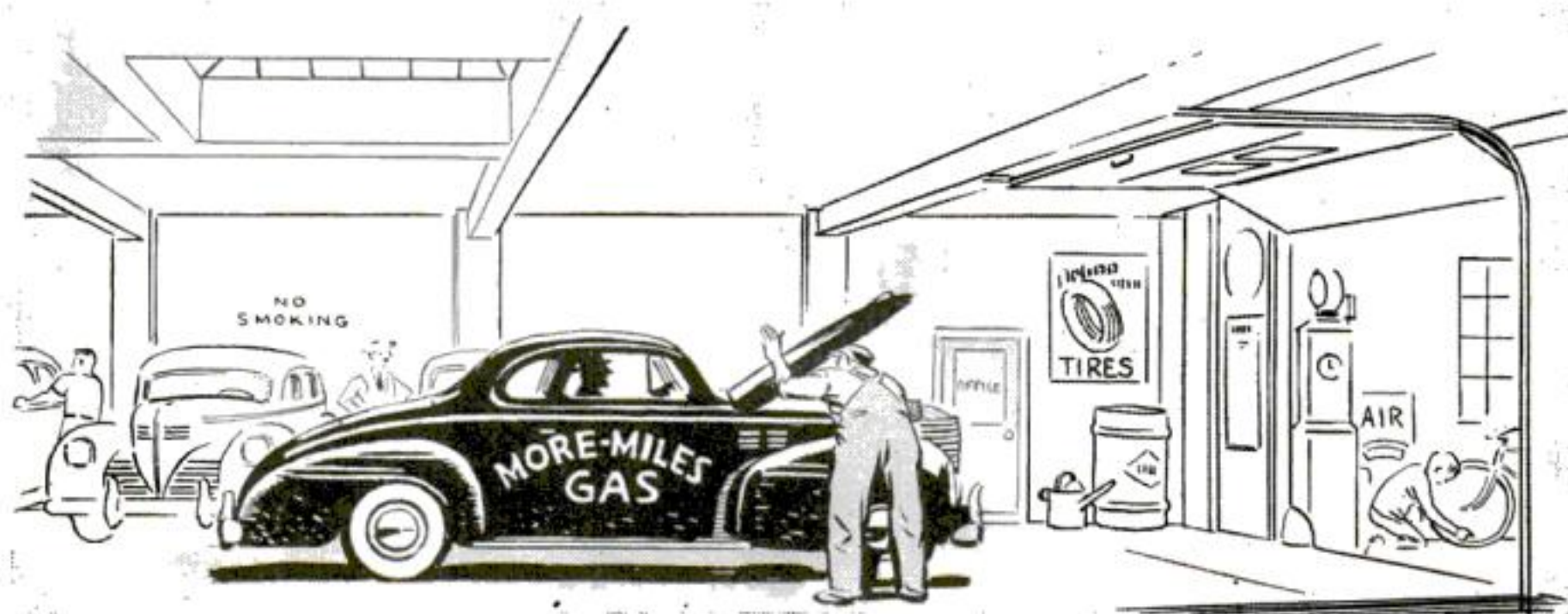
out I heard that tap-ticking for the first time. It sounded as though it was in the distributor shaft. I drove right back in again and told the fellow in the white coat about it. He called out the mechanic who had done my job, and after they had listened and palavered about it they took the generator and distributor off and checked them. They seemed to be O.K., so they put them back on, and when they started up the motor the noise was gone. So I drove out—and, by golly, I hadn't gone a block when the tap-ticking started again! I didn't have the time to go back again, but I've been hearing that noise on and off ever since then, and I want whatever's making it fixed!"

Gus listened again. "It does sound as if it is in the distributor," he agreed, "but I'll make certain." He got a two-foot length of quarter-inch steel rod from the shelf over his work bench, bent his thumb over its upper end, pressed his ear firmly against his thumb, and listened intently as he brought the rod's lower end into contact with various parts of the engine. "No," he decided after a minute or so, "the noise isn't in the distributor. It's in the crankcase—but the funny thing about it is that it moves around in the crankcase."

He stood thinking for a couple of minutes. Then he took the breather cap off the oil-filler pipe, and spent a couple more minutes listening intently at the opening.

Presently he called Harry, the grease mon-

Gus inserted the tester in a spark-plug hole and asked Hargrave to step on the starter



Secret

HIS PATIENTS' TROUBLES

By
MARTIN
BUNN



He stood thinking for a couple of minutes. Then he took the breather cap off the oil-filler pipe

key, and told him to drain the oil and let down the crankcase. He went over to his bench again and struck up an argument with his customer on the advantages of fresh-water fishing over the deep-sea variety. It was not Gus's habit to argue with customers, but Joe Clark, his partner, had prevailed on Gus to take the coming weekend off for a go at his favorite pastime—outside the Model Garage—fishing. And, to put it mildly, Gus was feeling "set up" already. Besides, Pond looked as if he loved an argument, and Gus knew more good than harm would come of it.

At a word from Harry, who had completed the task of letting down the crankcase in what Gus figured was roughly twice the time it would have taken him to do it himself, the two men broke off their friendly tiff and approached the problem of the car again.

"Let's look in that thing," Gus said, kneeling over the greasy pan. "What's this?"

His keen eye spotted a dark round object nestled up against a baffle plate of the case, and he picked it up. It was a half-inch, hexagonal nut.

"There's your tap-ticker!" Gus said. "I suppose that while that mechanic was working on your car yesterday he accidentally dropped the nut down the breather pipe. Since then it has been washing around in the oil, and every once in a while the crankshaft would hit it and knock it against the side of the oil pan, high up—that's what made the noise that bothered you every few minutes. No harm done—as soon as Harry replaces your crankcase and refills it you'll be ready to roll."

"There *are* some smart mechanics left!" Pond remarked. "Well, you've made me a steady customer of yours—for a long time I've been looking for a fellow like you and a shop like this!"

Gene Hargrave, who is a big-money sales-promotion man for More-Miles gasoline and

oil, and an old friend of Gus Wilson's, drove his classy coupe into the shop an hour or so after the highly-satisfied Pond had driven out. "Hello, Gus," he greeted. "How good are you at keeping a secret?"

"What's the gag?" Gus wanted to know, not quite sure his friend was serious.

"No gag at all," Hargrave assured him. "I'm on a spot. I've got to have a job done on this bus, and I can't afford to let anyone in the business know that I'm having it done."

"Deep stuff, hey?" Gus said, grinning. "All right, Gene—I'll keep mum about it. What's the mystery job?"

Hargrave got out of his car, snatched a fill of Gus's tobacco, perched himself on the end of the workbench, and lighted his pipe.

"Here's the layout," he explained. "Naturally, I use More-Miles gas and the best grade of More-Miles oil in my car. Equally naturally, I do everything that I can to get the best performance possible out of the products I sell—keep my engine in the very best condition, change my oil every thousand miles, and so on. That's good business for me. I can talk about the big mileage I get out of More-Miles gas in my car, and the smooth running of my engine is a grand advertisement for our oil.

"Now I'm going to tell you something that I don't want anyone else to know, Gus. Although my car is only a year old, the piston rings are very badly worn. I'm sure that it isn't the fault of our oil, but lots of people would think that it is. I want you to order a new set of rings and slip them in sometime when there's no one around who'll ask questions about whose car it is. Got me?"

"Yes, I've got you," Gus said. "But what makes you so all-fired certain that your rings have gone bad?"

"It couldn't be anything else," Hargrave asserted. "I've got too much oil—every time I change it I take out a quart or so more than I put in the last time I changed it. I've checked on everything. The dilution isn't caused by water from the cooling system leaking in—I never have to add a drop to what's in the radiator. There's nothing the matter with the carburetor choke—it doesn't stick in the choked position. It *must* be the rings—they're worn so badly that the gas leaks past them and the pistons

into the crankcase. I'm dead certain of it!

"You can see why I'm on a spot. The condition of my engine after only a year of running doesn't make More-Miles look like as good an oil as it is, and it would hurt the sale of More-Miles products in this district if the story about those bad rings got out—to say nothing about the kidding and razzing I'd have to stand for!"

"The story won't get out of this shop,"

Gus said. "I'll get your car fixed up as quickly as I can. But maybe you're wrong about those rings, Gene. Better let me check over your engine before I start tearing it apart."

"Go ahead and check it," Hargrave told him. "But I'm right about the rings."

Gus got his vacuum tester out and soon reported that the manifold pressure was normal. Then he con-

nected the compression tester to each spark-plug hole as Hargrave stepped on the starter. "There's nothing the matter with those rings, I tell you!" Gus said.

"Well, then," Hargrave demanded, "where does that dilution of the oil come from?"

"That's what we've got to find out," Gus said. He took the carburetor off and examined it. "That's O.K.," he decided. "I'll have a look at the fuel pump." He removed it from the engine, and washed it off with gasoline. Then he whistled. "What's this?" he asked, pointing to a small patch of solder.

"Oh, I did that little job myself," Hargrave said. "I noticed gasoline leaking out of a small hole, so I soldered it shut—even a little gas leak means less mileage."

Gus laughed as he drove the solder out of the hole with a small punch. "You *are* a wise guy, Gene," he said between chuckles. "That hole you soldered up so carefully is a telltale—one of its purposes is to give warning, by gasoline leaking out of it, that the pump's diaphragm is broken or leaking. That's why your oil is diluted—gasoline has been leaking through the diaphragm into the crankcase. Those piston rings haven't anything to do with it."

"Huh?" muttered Hargrave. Then he saw the light, and did some fancy cussing. "I *am* a sap!" he confessed after a while. "Put in a new diaphragm, will you, Gus? And, say—if this story ever gets around—"

"I told you," Gus reminded him, "that I can keep a secret. I can—and I will!"

GUS SAYS:

Keeping the distributor cap, spark-plug porcelains, ignition wires, and high-tension side of the coil clean by occasional wiping with a clean cloth will make your car start a lot easier on damp or rainy days. You'll find it makes your motor run better and more economically, too.

THE HOME WORKSHOP



In This Issue.. SOAP-BOX RACING • SURFBOARD SAID
TRICK PHOTOS • ARCHERY • SHOP KINKS

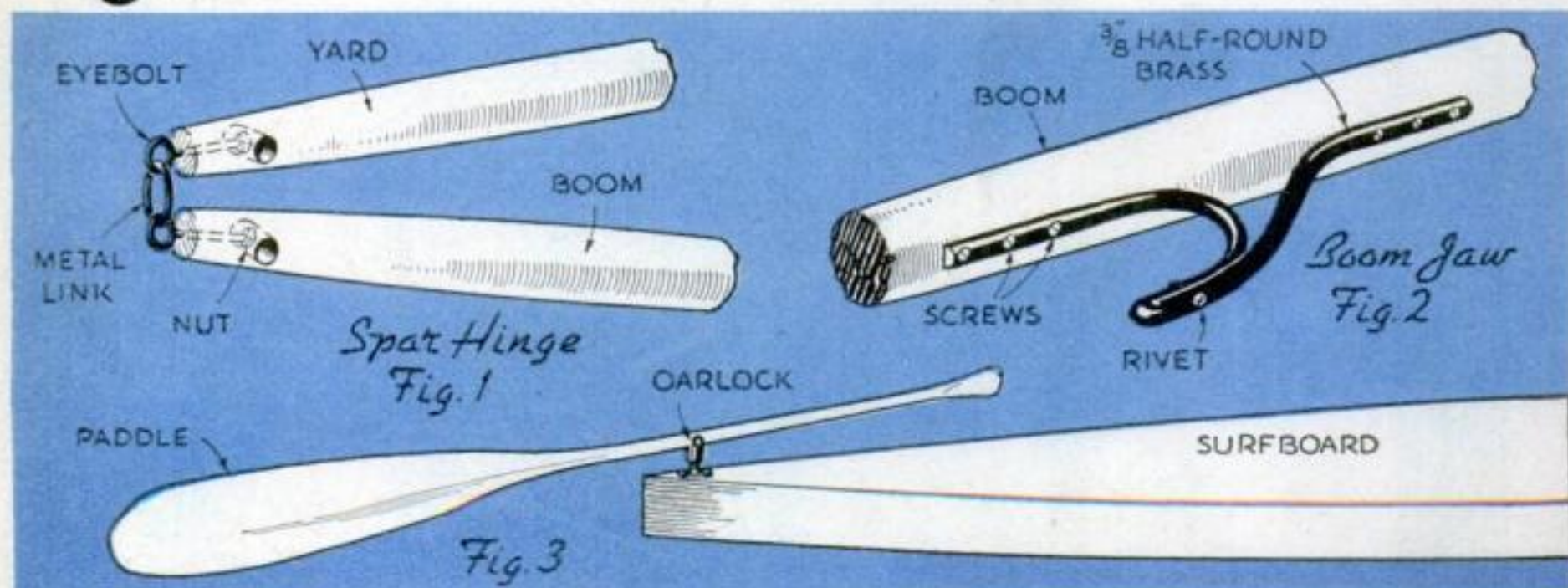
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Surfboard Sailing Rig

IT IS a strange, happy feeling to skim the water before the wind on a sailing surfboard. To enjoy this sport, you don't have to be an athlete with a fine sense of balance and lots of nerve, nor do you have to wait until some friend comes along with a speed boat to give you a tow.

The board should be of the hollow streamline (pointed stern) type, rather than a square-tail board. One standard size in common use is 14' long, 23" wide



at the widest point, and 5" deep. This board is suitable for a person weighing up to 175 lb., and it can carry as much as 40 square feet of sail. If the board is shorter, allow about 3 square feet of sail to each foot length of the board.

The familiar lateen type such as is used on canoes will give good results. Because the surfboard itself weighs so little, a light sailcloth of unbleached cotton duck is desirable. A $\frac{1}{4}$ " diameter rope may be sewed along the luff (hoist) and foot of the sail to prevent stretching.

Battens are generally made of scrap decking or any soft wood available. Space the battens so as to divide the leech of the sail into four parts. Battens should be $\frac{1}{4}$ " thick by 1" wide and tapered to about $\frac{1}{8}$ " thick at the forward end; they are 12" long. Their object is to hold out the leech of the sail.

Booms and mast should be made of clear, straight-grained spruce. The booms should be 6" longer than the sail measurement, as stretching of the cloth may occur. A good length is 7' 6". Have the booms ripped to about $1\frac{1}{2}$ " square, then work them down to a diameter of $1\frac{1}{4}$ " at the center, tapering uniformly to 1" at both ends. The spars may be hinged together with two eyebolts, 2" by $\frac{1}{8}$ ", as sketched in Fig. 1.

The boom jaw (Fig. 2) is made of $\frac{3}{8}$ " half-round brass, attached to the boom with brass screws. It is placed so the mast center is 18" from the end of the spar.

The mast should be 5' 6" long. The finished diameter is 2" at a point 24" from the bottom, and tapered off to $1\frac{1}{2}$ " at the top. Mount a sheave near the top for hoisting the sail. Drive out the pin of any small galvanized pulley to obtain the wheel; then slot the mast for this sheave and mount it on a bolt run through the mast.

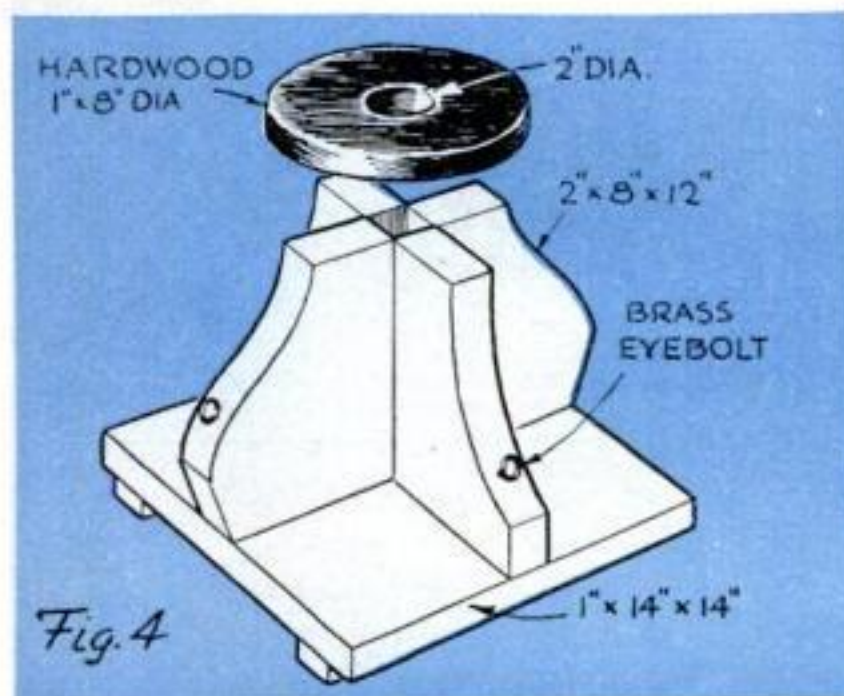
The mast step, which is removable, is made of four pieces of wood, each measuring 2" by 8" by 12". These are band-sawed approximately as shown in Fig. 4 so as to leave them about 3" wide at the top and 6" wide at the bottom. They are fastened to a baseboard of 1" stock, 14" square, in such a way as to leave a 2" square space to receive the mast.

A COLLAR of hardwood, 1" thick and 8" in diameter, is fastened to the top of the supporting blocks. It has a 2" hole in its center, which fits the mast snugly. An eyebolt is inserted in the collar for the single halyard. One brass eyebolt on the starboard and one on the port side of the mast step are used to secure the device to the surfboard. A $\frac{3}{16}$ " cotton line is run through the eyebolts and underneath the board a half dozen times. This line clamps down tight when wet and securely holds the rig.

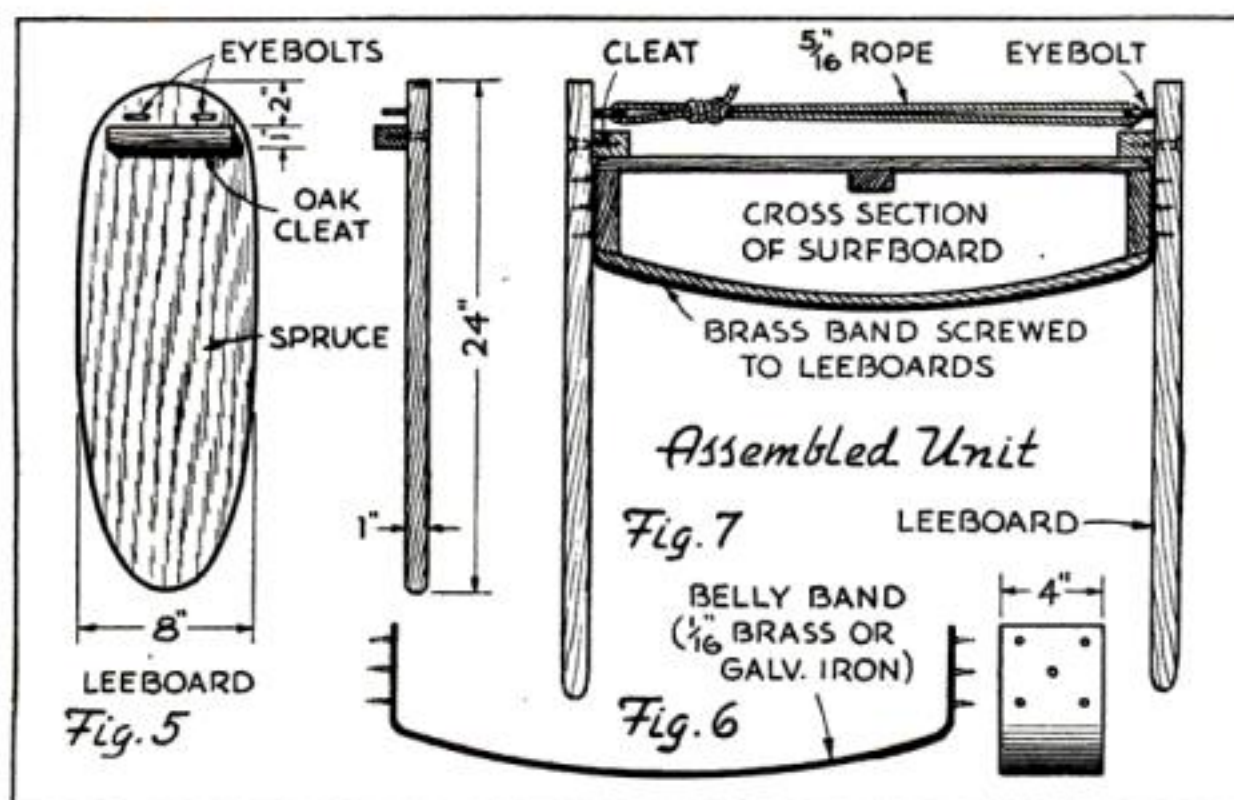
The sailing surfboard may be steered either by dragging a foot rather deep in the

How to make the mast step, sail, spars, and leeboards

By TOM BLAKE



Tom Blake, who is the world's leading authority on surfboards, rigs up a sail on a new streamline board



A pair of small leeboards are added in order to tack or sail into the wind

of 1" stock, 8" wide by 24" long. Each has a cleat near the top and two eyebolts as shown in Fig. 5.

For securing the leeboards, I suggest the method shown in Figs. 6 and 7. A brass band or one of galvanized iron is bent to conform snugly to the bottom and sides of the surfboard and screwed to the leeboards. The cleat near the top of each leeboard keeps it in the proper position. A 5/16" line is drawn through the eyebolts on each blade.

The leeboards will be most effective if placed at the widest part of the board. They should be set parallel to the length of the board to prevent undue drag or interference with the steering.

water or with a canoe paddle (Fig. 3). The paddle is fastened to a small oarlock so as to swing freely, and is held by the feet of the rider. The boom is controlled by 1/4" line running through an eyebolt at the stern of the board to the hand of the swimmer.

While a board thus rigged will run well before the wind, to sail into the wind and to permit tacking it is necessary to use leeboards. These serve the purpose of a centerboard in a sailboat. The leeboards consist of two wooden paddle-shaped blades

Instructions for building a hollow surfboard of the latest type were given by Tom Blake in the June, 1939, issue of POPULAR SCIENCE MONTHLY. For general methods of laying out, cutting, and sewing small canvas sails, see P.S.M., July '39, p. 160, and May '40, p. 176.

New Croquet Mallet for Trick Shots

DIFFICULT croquet shots, such as only experts can make with ordinary mallets, can be duplicated by comparative beginners with the new type of croquet set illustrated. Each mallet has a rubber insert in one end. Striking the ball with this end will, after a little practice, result in shots with considerable "English." The other end is used for straight shots.

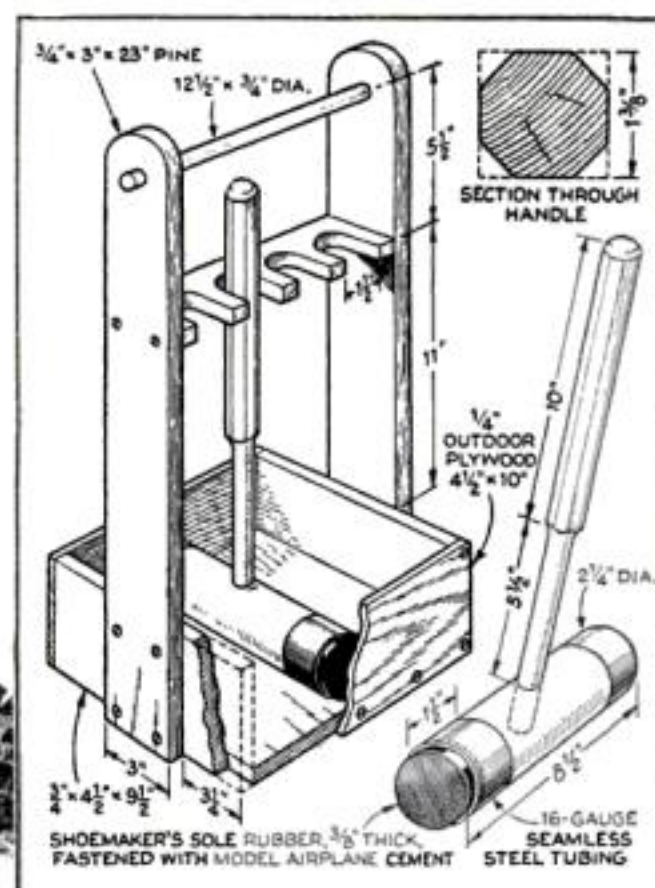
The mallet head is of mahogany, with bands of seamless steel tubing over each end. The wood is turned with a 1/32" taper, and the bands are forced on to fit tightly. The handles are of hickory.

A carrying case for the set may be constructed as shown. A simple way to distinguish between the mallets is to cut a different number of narrow grooves or lines around the top of the handles.

The set was designed by Fred F. Latshaw, manual-arts instructor at Pasadena Junior College, Pasadena, Calif.



OUTDOORS



One end of each mallet is faced with thick rubber, which enables a beginner to play much more expertly

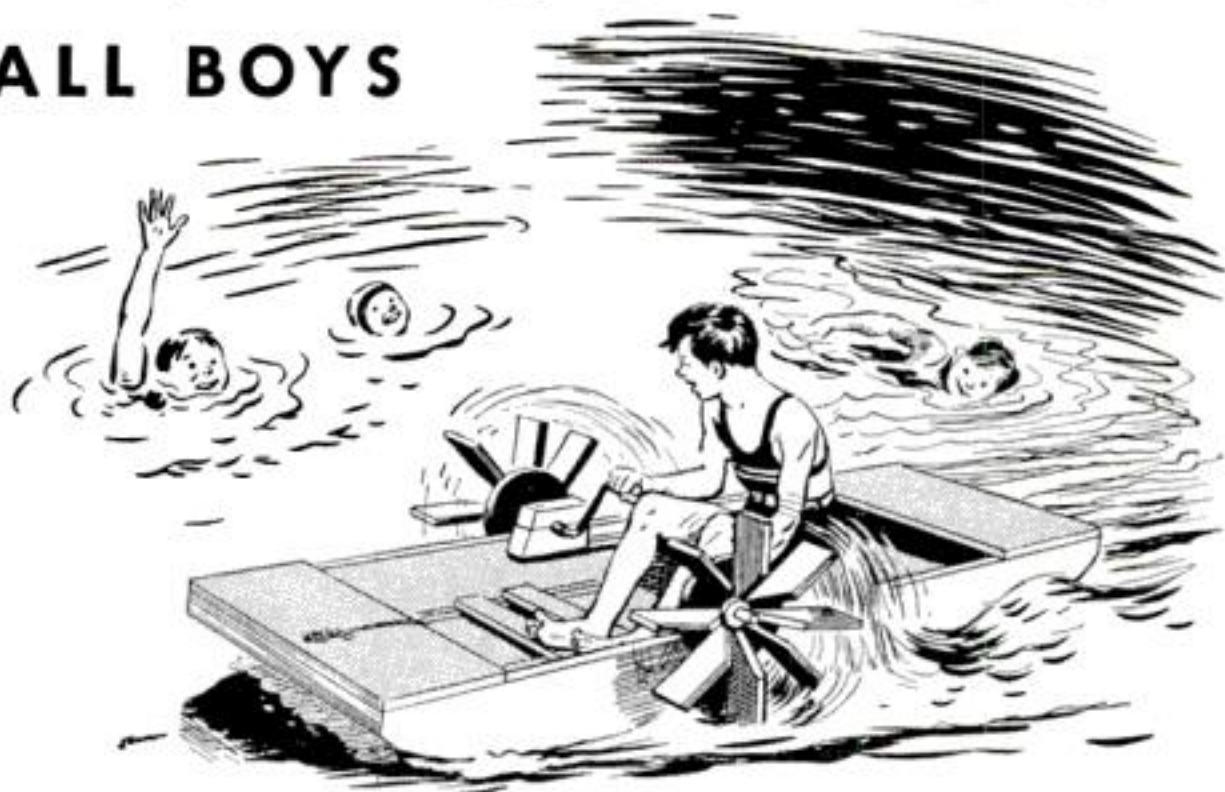
Paddle-Wheel Boat

PLEASES SMALL BOYS

NO BOAT-BUILDING experience is necessary to construct this juvenile side-wheeler because the bottom is a single panel of waterproof outdoor plywood. The only calking required, along the chines (lower edges), is simply a matter of laying cotton binding tape in marine glue and screwing on the plywood.

First cut the side members and fasten the chine strips flush with the lower edge of each. Assemble the sides with the cross members at the ends, using marine glue in all joints. With the frame upside down, screw on the bottom panel. Add the keelson or inside keel, which is made in three parts like the chines, and screw on the keel. Finish the remainder of the woodwork as shown.

The crankshafts for the paddles require some forge work, since they must be bent to a right angle in two places to form the crank. The other end of each is drilled and reamed for a taper pin; or a straight pin may be used and peened over to hold it in place. The crank end is threaded for a nut to retain the wooden handle. These shafts



Fun galore awaits the boy who owns one of these boats this summer

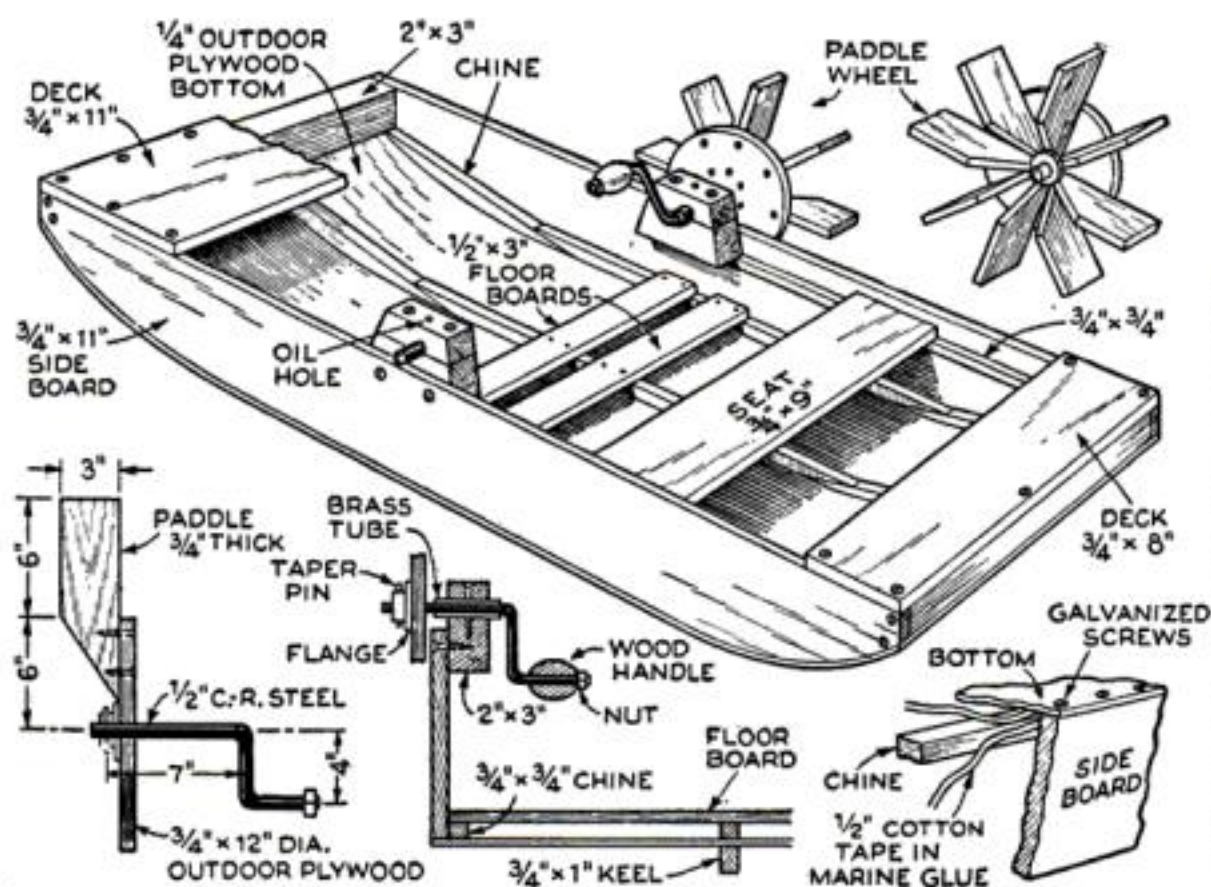
turn in short sections of brass tubing, provided with oil holes.

Each paddle is merely a disk of outdoor plywood to which the eight paddles are screwed. The disk is then secured to the shaft with a flange and a taper pin, straight pin, or set screw, as preferred. The seat rests on cleats so that it may be moved forward or aft to accommodate the "engineer." Light floor boards, laid crosswise, form a false bottom.

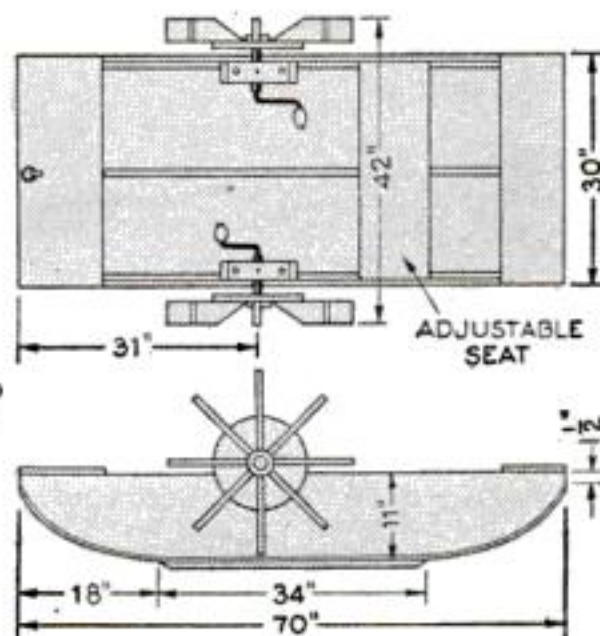
Paint in colors of your own selection, but do not use a quick-drying paint or enamel on the outdoor plywood as it may not stand up so well in use.

Steering is accomplished by reversing one paddle and going ahead with the other.

By **DICK HIXON**

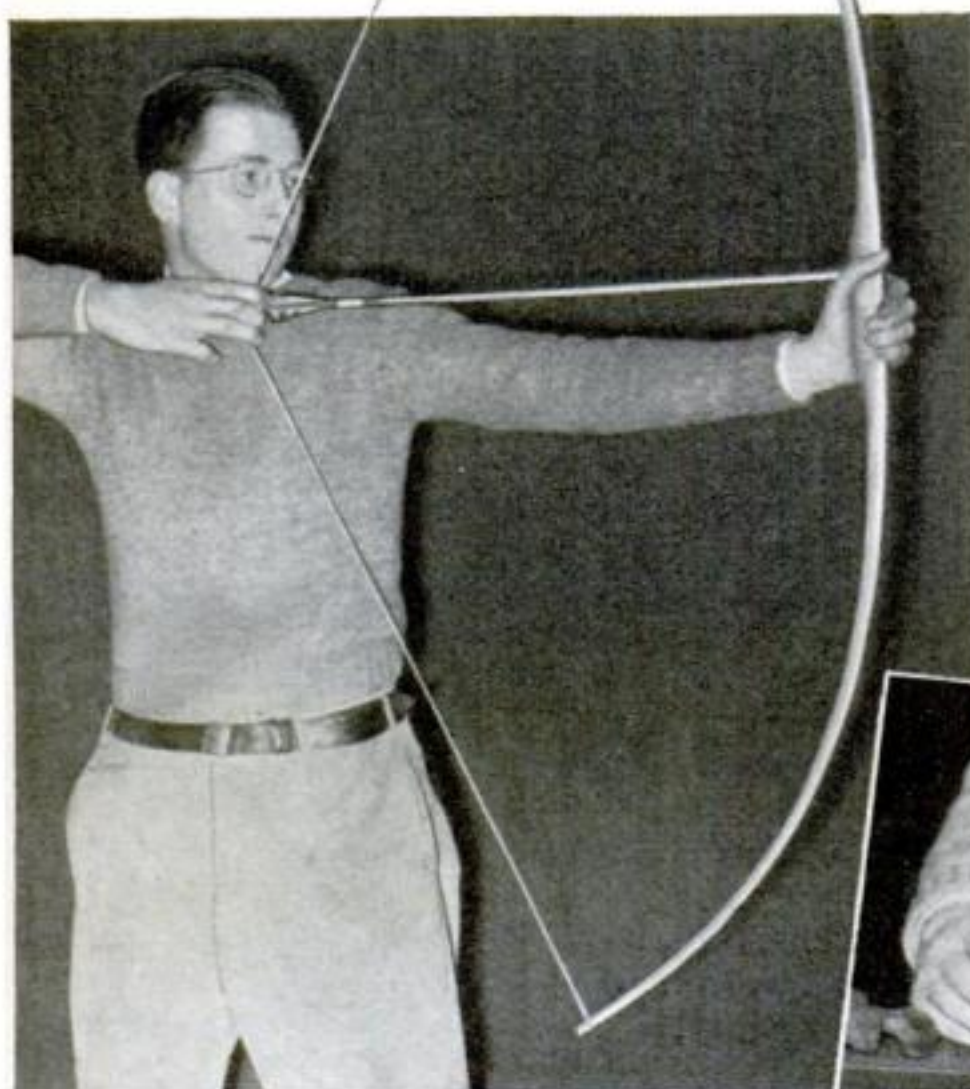


The paddle-wheeler is almost 6' long and will safely hold a boy weighing not more than 100 pounds



Amazing New Silk Backing

By
ALFRED
P.
LANE

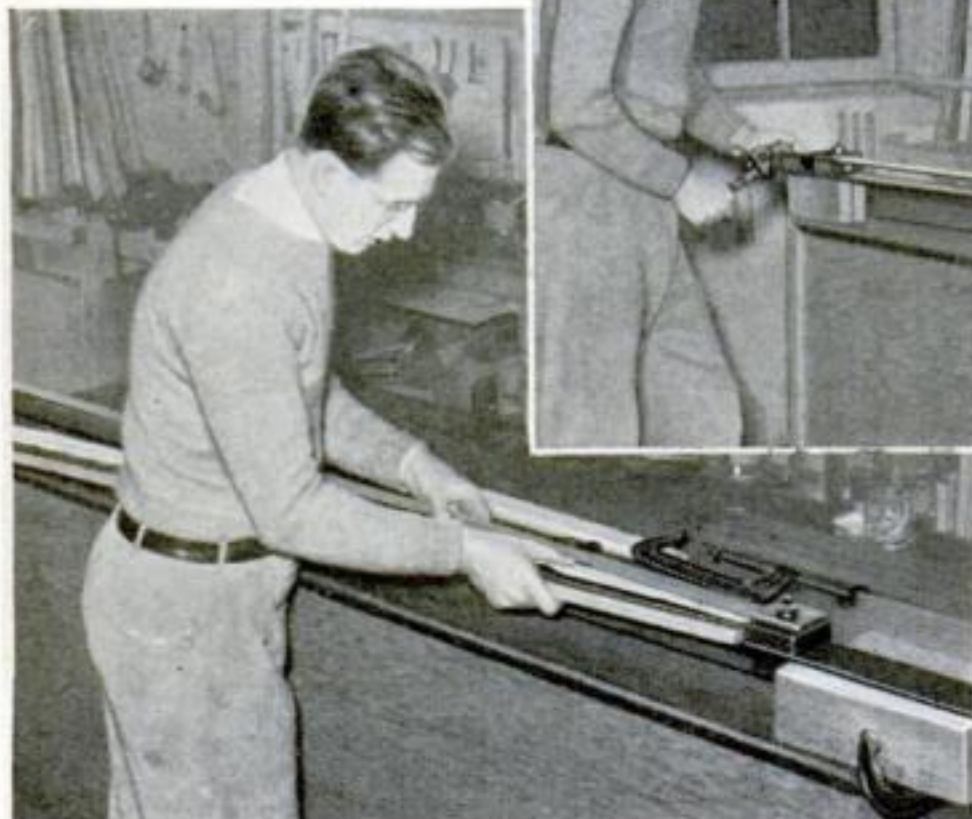
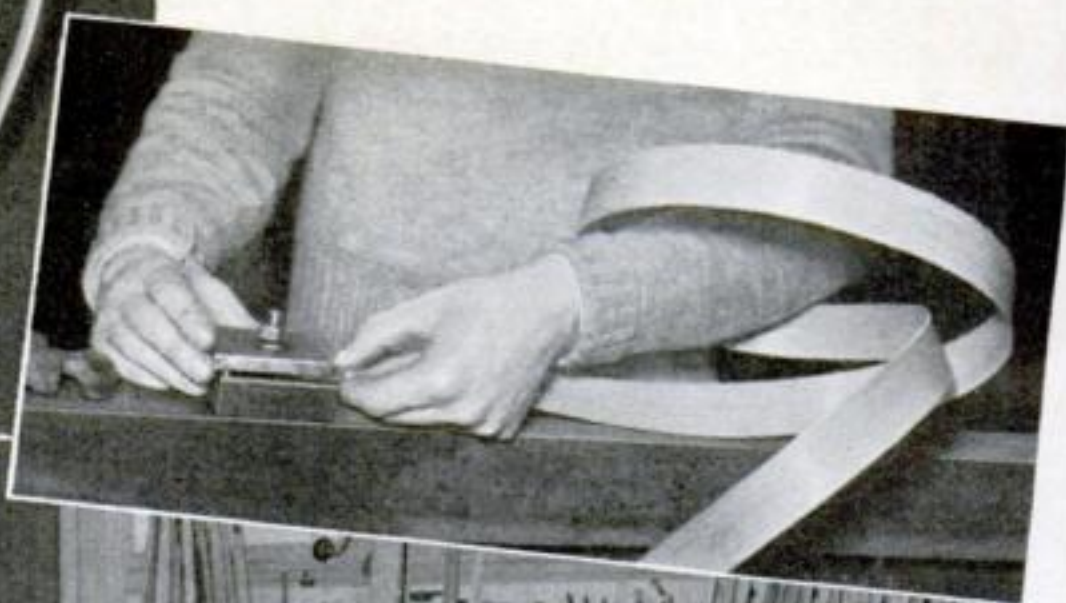


"Dutch" Weese, long the Eastern champion, draws a bow backed with the new material

USING raw silk fibers, Dr. C. N. Hickman, of New York, who has made many notable scientific researches into archery problems, has finally developed a backing for wooden bows that may revolutionize the art of bow making. Glued to the back of a bow while under heavy tension, this remarkable new material greatly increases its drawing weight and cast—that is, its actual shooting efficiency. Other backing materials, such as calfskin or compressed fiber, merely guard a bow against breaking.

An important feature of the new backing is that it yields but little to the strain of constant bending. Bows fitted with it do not "follow the string" or gradually assume a set curve when unstrung.

Applied to the back of an old bow that has seen plenty of service, it acts as a rejuvenator. The bow regains



The ends of the silk backing strip are clamped between layers of sandpaper to a stretcher in such a way that tension can be applied with a big bolt

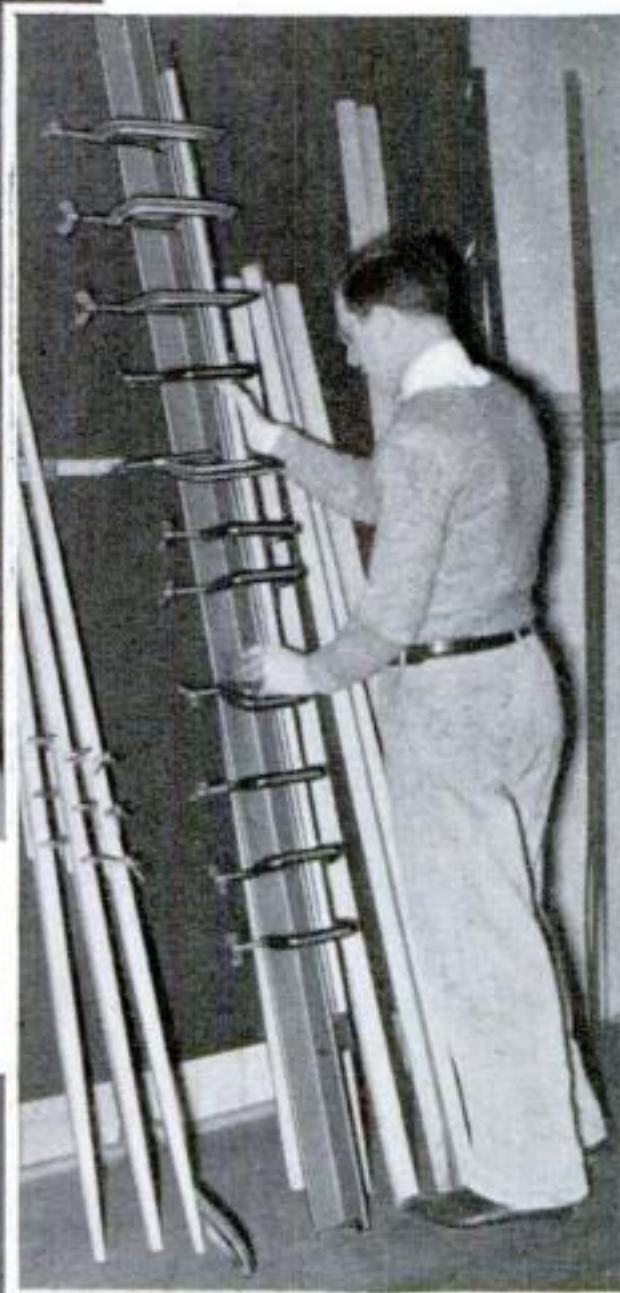
At left, a cloth-padded filler strip is placed under the stretched backing to distribute the pressure of the C-clamps

Peps Up Archery Bows

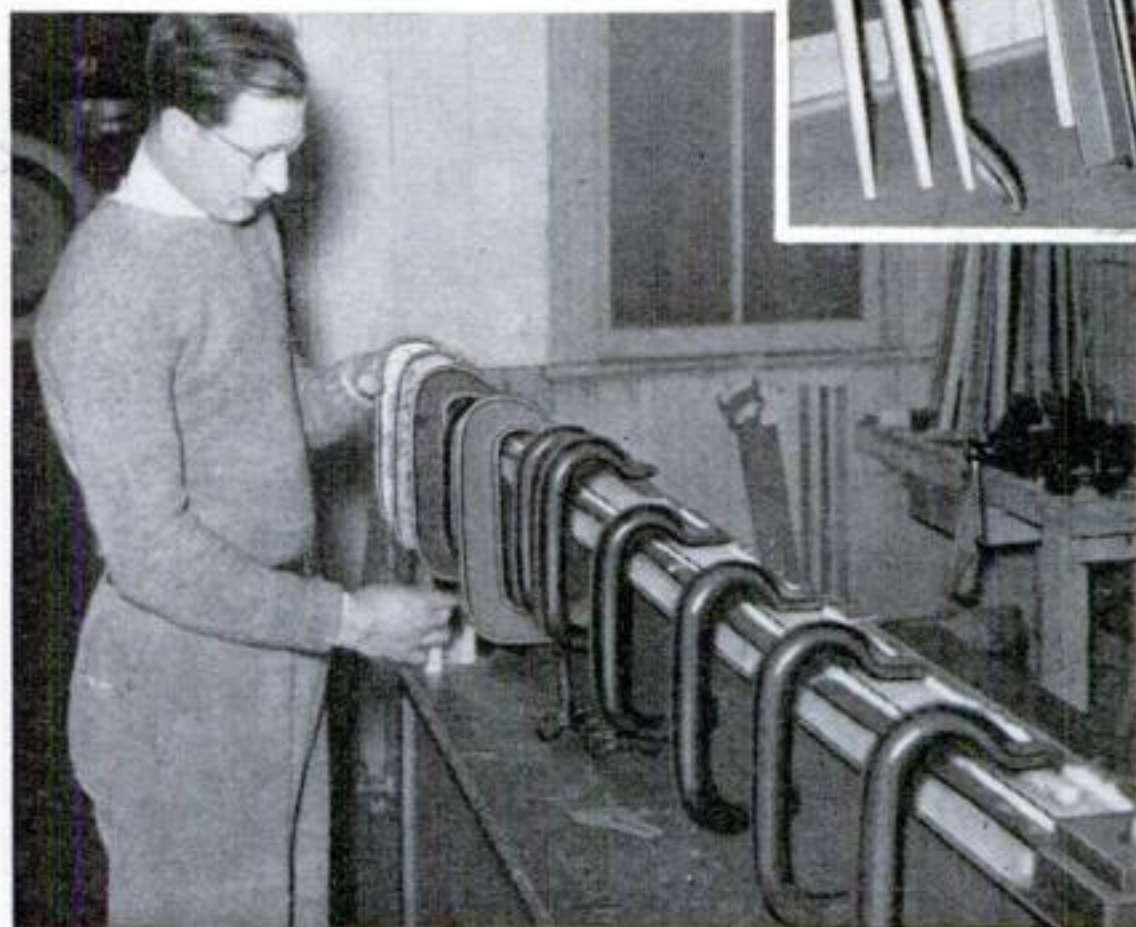


After being coated with glue as above, the bow is laid on the stretched silk. The padded filler strip is brought up underneath, and clamps are then applied

The entire stretcher, with the bow clamped in place, is stood up in a corner, as shown below, until the glue hardens



Note how the backing gives the bow a slight backward curve, thus increasing its strength



much of its lost cast, and the drawing weight is increased from 4 to 7 lb., depending on the type and length of bow.

The silk material has recently been made available to amateurs, and some of the

larger dealers in archery supplies now carry it in stock. To obtain its full advantage, it must be pulled taut and then stretched 1" before being applied to a lemonwood bow, or from 1" to 2" for yew or osage orange. To do this, a stretcher is necessary. The one illustrated is used by a professional bowyer and is very heavily built for constant service, but an amateur can easily improvise a suitable stretcher from a heavy plank or beam with a block at each end, across which the silk band can be stretched. One block should be mounted so that pressure can be applied with a screw or wooden wedges. Makeshift clamps can also be devised to hold the bow against the backing.

PORTABLE Beach Dressing Room

A RIVIERA
BATHING 'CABINE'
ADAPTED FOR
AMERICAN USE

By HI SIBLEY

PORTABLE beach dressing rooms have so many merits in respect to convenience, cleanliness, and privacy when compared with the average bathhouse locker room that they are becoming popular at some of the better beaches in this country. They have, of course, long been used abroad on crowded beaches because they can be rolled right to the water's edge, and valuables can be locked in and watched while bathing. Another advantage is that bathers need not walk across a wide stretch of hot sand or concrete.

The design shown is what is called a "bathing machine" in England or a "cabine" on the continent, but the construction has been improved by the use of outdoor plywood of a type recommended for beach equipment. The dressing room could be drawn right into the water without damage.

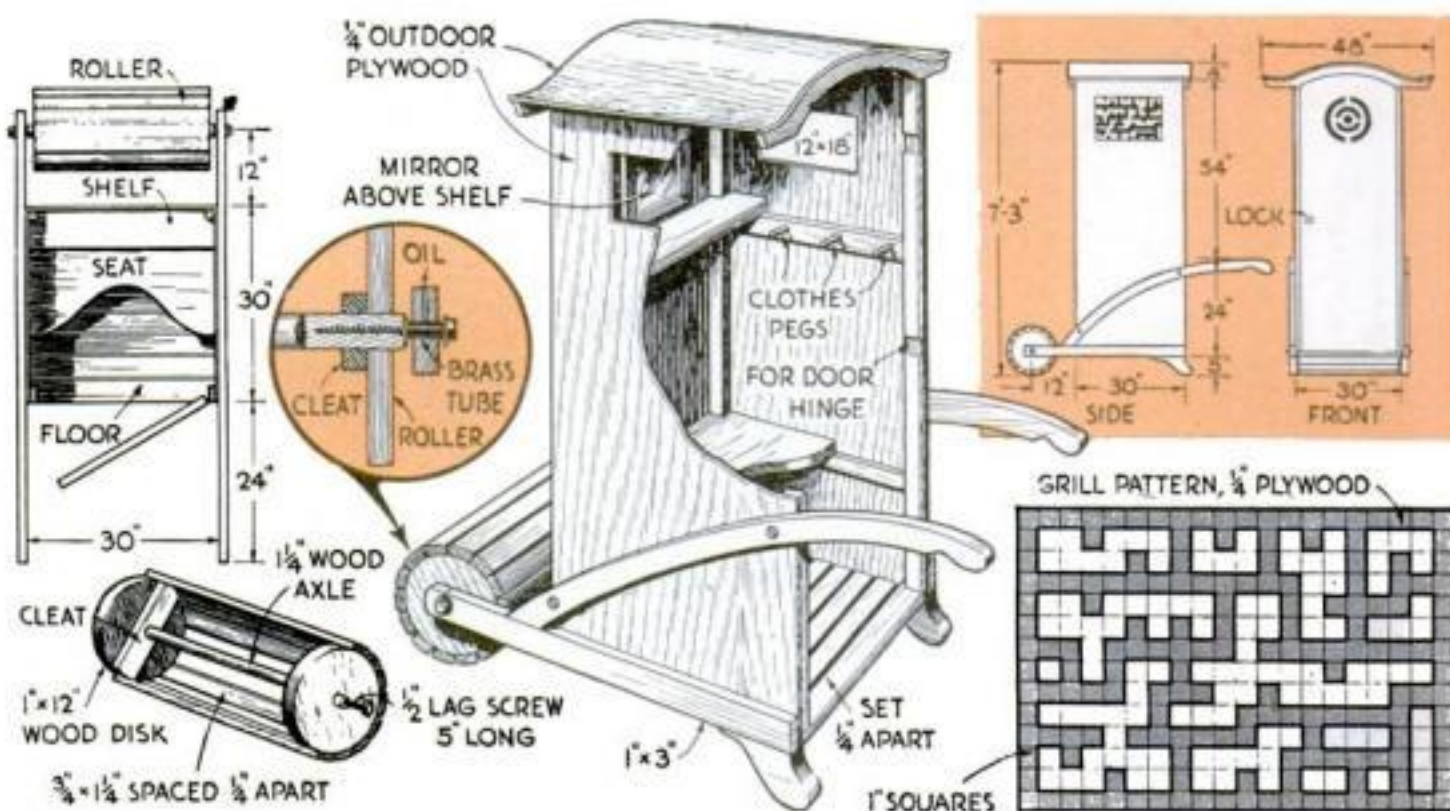
Roof, walls, and sides are of $\frac{1}{4}$ " plywood, casein glued and screwed to pine frame mem-

bers. The side panels are assembled separately, then joined with the floor unit and curved roof beams. Space the bottom boards $\frac{1}{4}$ " apart so that sand and water will not accumulate. To curve the roof plywood, wet the inside, as plywood fibers are more easily compressed than stretched in bending. Plywood grilles are screwed inside the wall

and door openings. Install a seat, shelf, and clothes pegs. Use wooden dowels for the pegs. Fasten a mirror to the back wall above the shelf as shown, and install a good lock in the door.

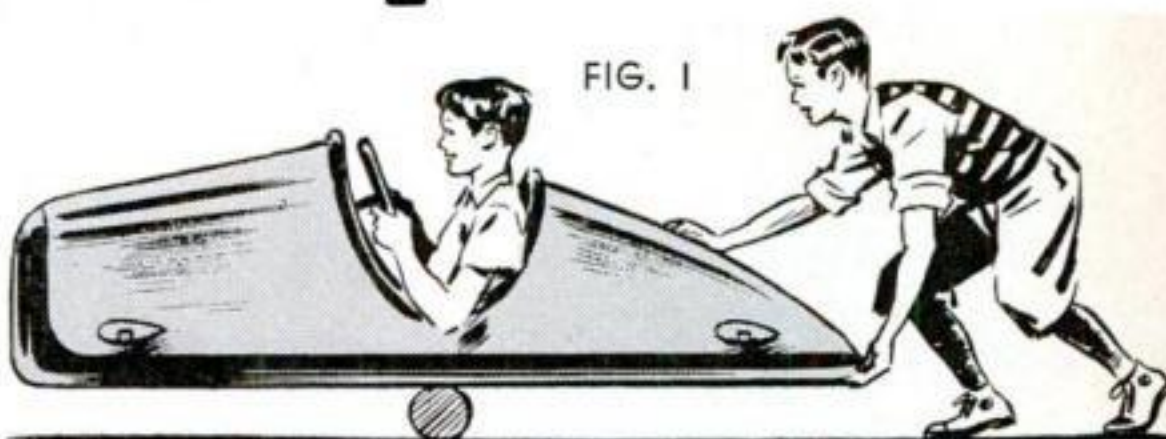
The type of roller illustrated is easy to trundle over dry sand, and the handles serve as drying racks for bathing suits.

Finish in a striking color combination so that the dressing room can be distinguished readily if lined up with others. Chinese red for the roof and cream with green or blue trim for the body will form an effective color scheme.



Tuning Up a Soap-Box Racer

HOW TO CHECK THE DISTRIBUTION OF WEIGHT . . . BALANCE THE WHEELS . . . RUN IN BALL BEARINGS



To see whether a car balances midway between the axles, remove the wheels and push it on a roller, with the driver in his seat

THOUSANDS of boys are tuning up their homemade soap-box racers to compete in the many regional contests to be held this season. They hope to become local champions and then go to Akron, Ohio, on August 11 to take part in the 1940 national and international finals of the All-American Soap Box Derby.

Most of these boys know the "1940 Official Rule Book" by heart and have done their best to comply with all its requirements. What they are anxious about now is how to make a final check-up that will insure getting the utmost speed out of their racers. Here are some points to consider:

Have the weight distributed as evenly as possible. To test, remove the wheels, place a pipe or roller under the body of the car, get in yourself, and have another boy roll the car on the pipe until it balances. This point should be mid-

way between the front and rear axles, as shown in Fig. 1.

Balance each wheel by drilling holes in the web on the heavy side or adding a stove bolt in a hole drilled in the light side.

The ball bearings of new standard wheels can be improved by running them in for an equivalent of several hundred miles on an

improvised motor-driven test block such as is illustrated in Fig. 2. Number each wheel for identification and add an arrow to show the direction of rotation. Clean out the bearings at intervals with carbon tetrachloride and an air pump; then apply fresh oil.

See that the axles are so well reinforced they cannot bend and cause misalignment.

Check the wheels very carefully for alignment as in Fig. 3.

In mounting wheels, turn the nuts to a snug fit, then back them off one castellation before putting in the cotter pins.

Check and recheck the steering. Wire all turn-buckles so that they cannot loosen. Use large pulleys and oil the cable where it runs over them. Do not have much play, but do not make the control so sensitive the car will weave.

If springs are used, be sure they are applied so that the wheels cannot get out of alignment when racing. Use scrupulous care in cleaning bearings before the race. Oil them *sparingly* with a light oil.



FIG. 2

Test block for running in the ball bearings of new wheels. The design was suggested by Robert R. Fisher, of Detroit

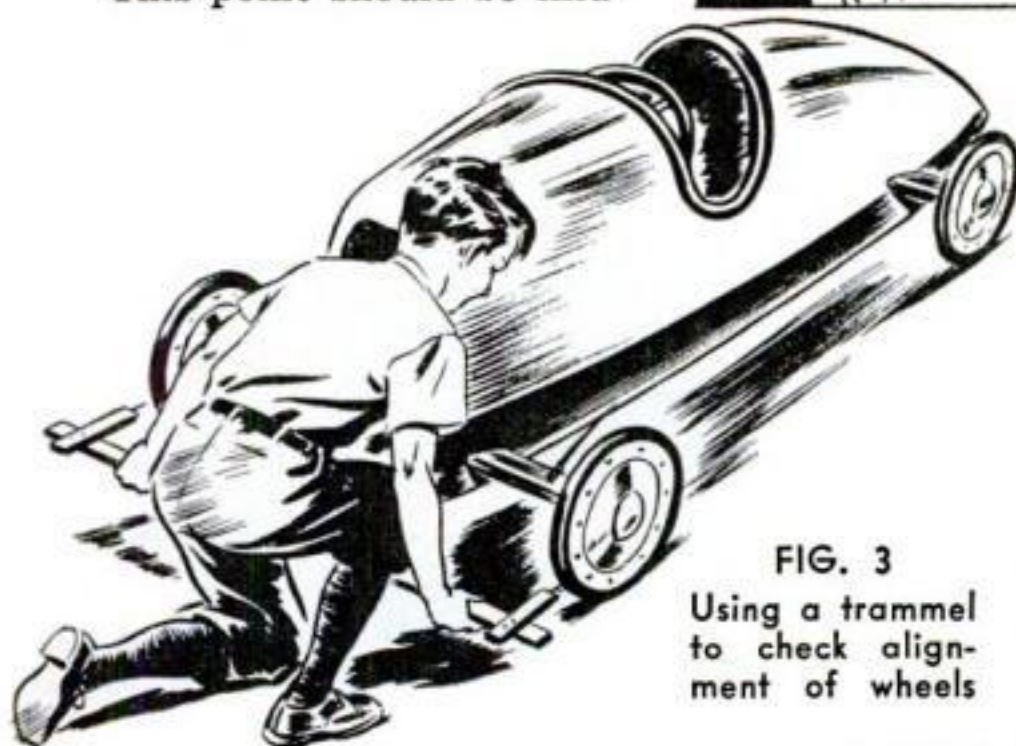
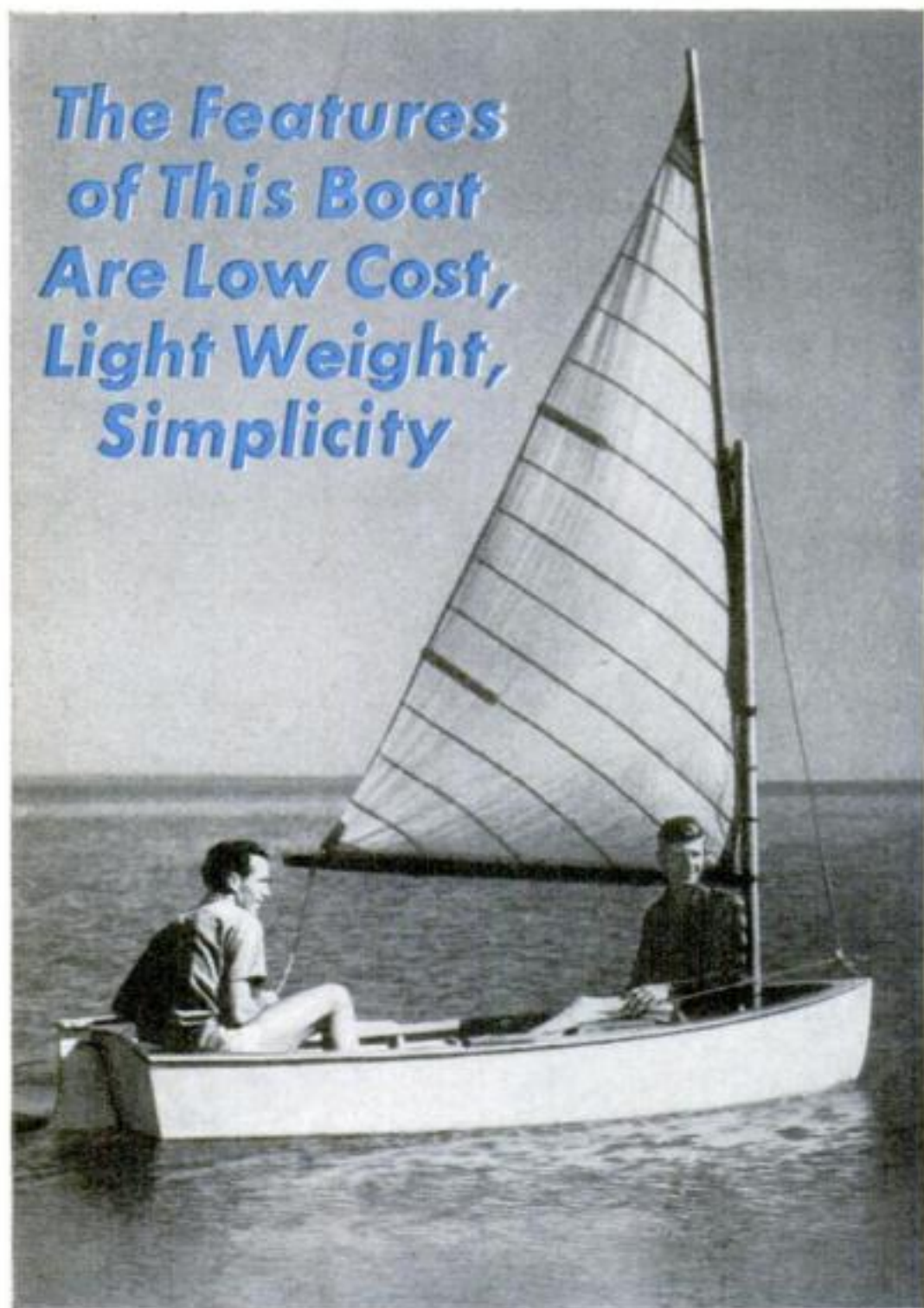


FIG. 3

Using a trammel to check alignment of wheels

HOW TO COMPLETE OUR NEW Plywood

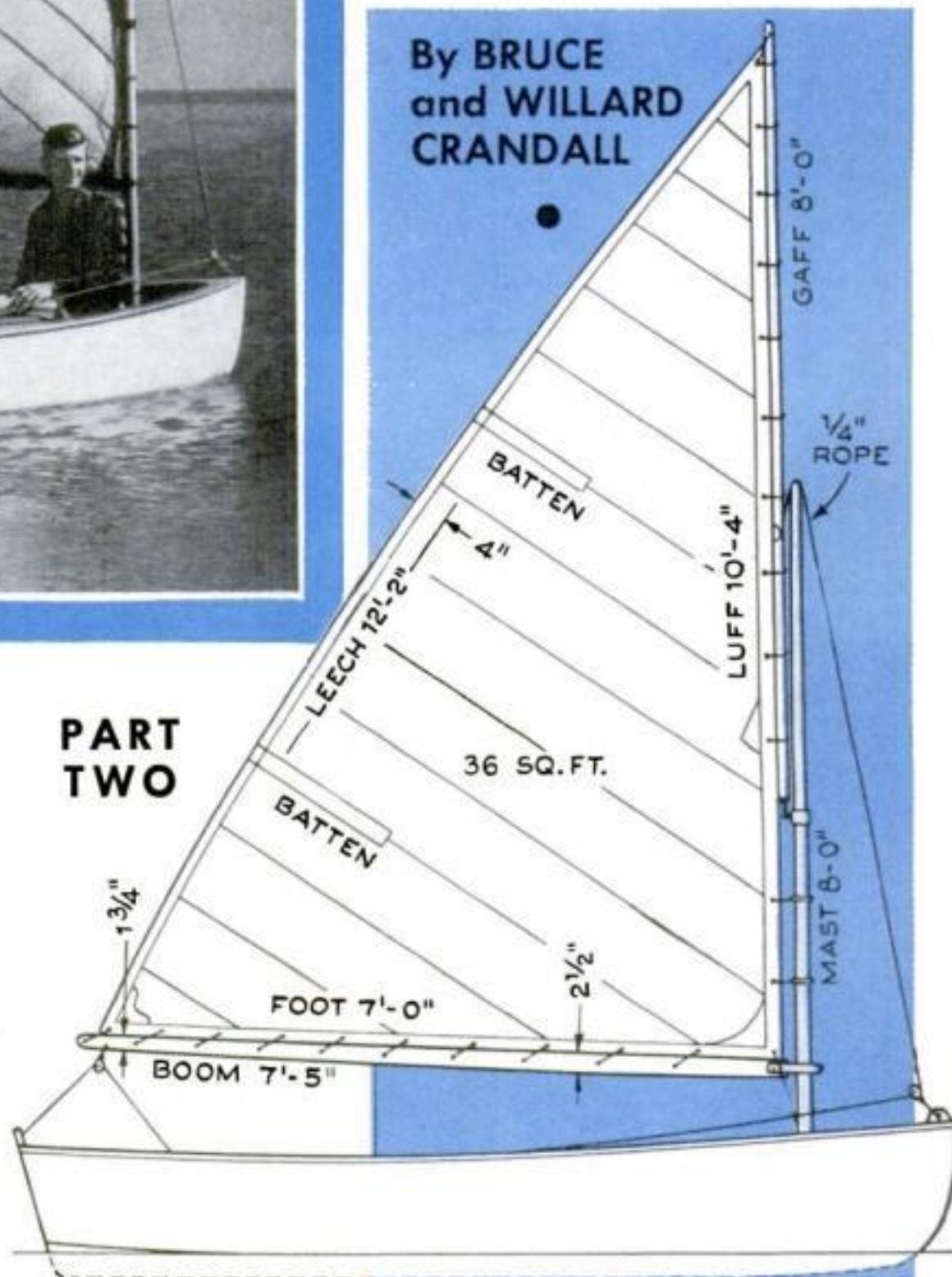
**The Features
of This Boat
Are Low Cost,
Light Weight,
Simplicity**



the boat slightly out of shape.

The planking is fastened with flathead screws as follows: (1) Into chines, $\frac{7}{8}$ " No. 7, spaced about 2" apart; (2) into transom frame and stem, $1\frac{1}{4}$ " No. 7, spaced about 1" apart; (3) into side frames, $1\frac{1}{4}$ " No. 7, about four to each frame. The holes for the screws should be countersunk only enough so that the screw heads are approximately flush with the outside of the planking. The screws into the chine should be carefully placed so

By BRUCE
and WILLARD
CRANDALL



The sail plan. Above at left, the dinghy makes exceptional speed with only a fair breeze

IN APPLYING the waterproof plywood to our new 9' 7" sailing dinghy *Breeze Along*, the side planks are put on before the bottom. Their shape is determined by clamping or holding the sheet of plywood in place and then marking the shape on the plywood. After the piece for one side is sawed out, it should be tried on the opposite side. If it fits well enough, it can be used as a pattern for the plank on that side.

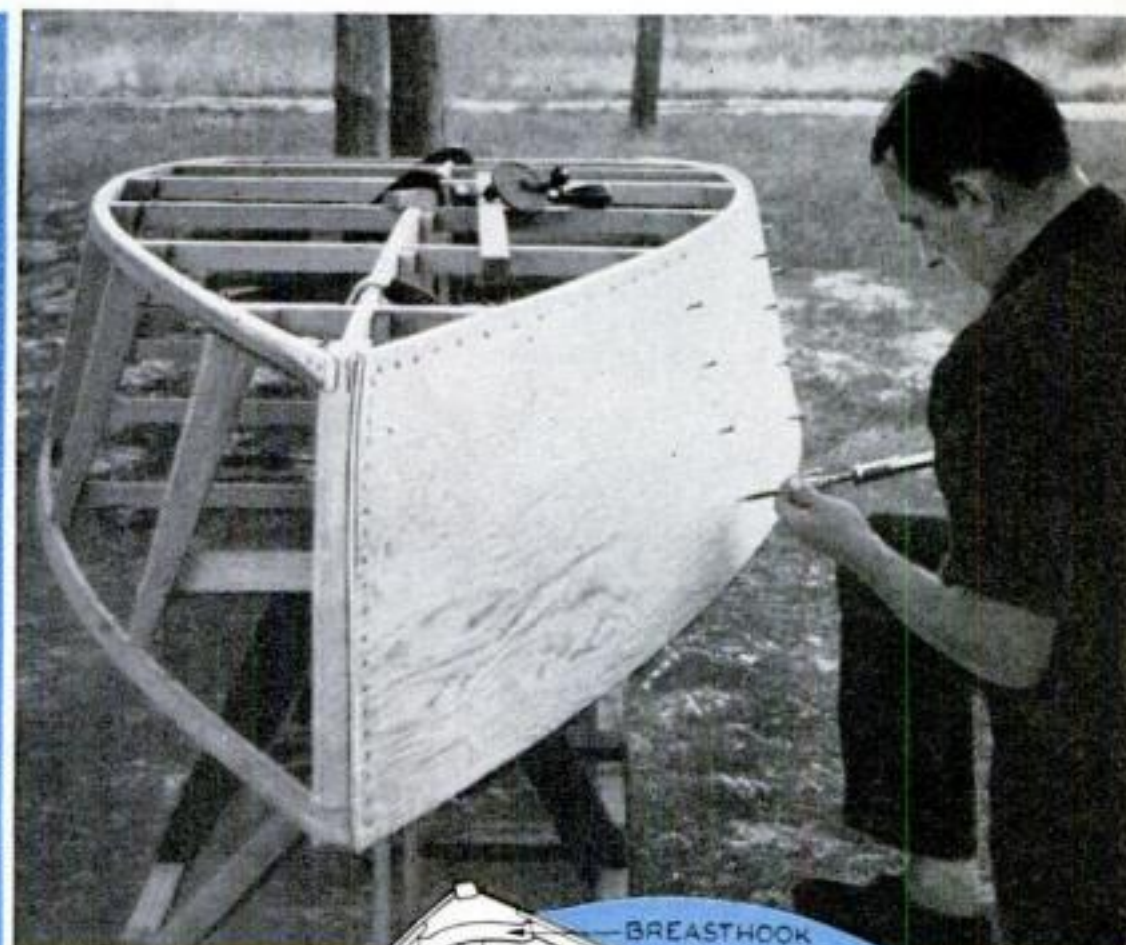
Before the side planking is fastened in place, the edge of the chines, stem, and transom should be coated with marine glue. Unless the framework is well braced, it will be best to fasten both sides in place at the same time, so as to prevent pulling

**PART
TWO**

Sailing Dinghy



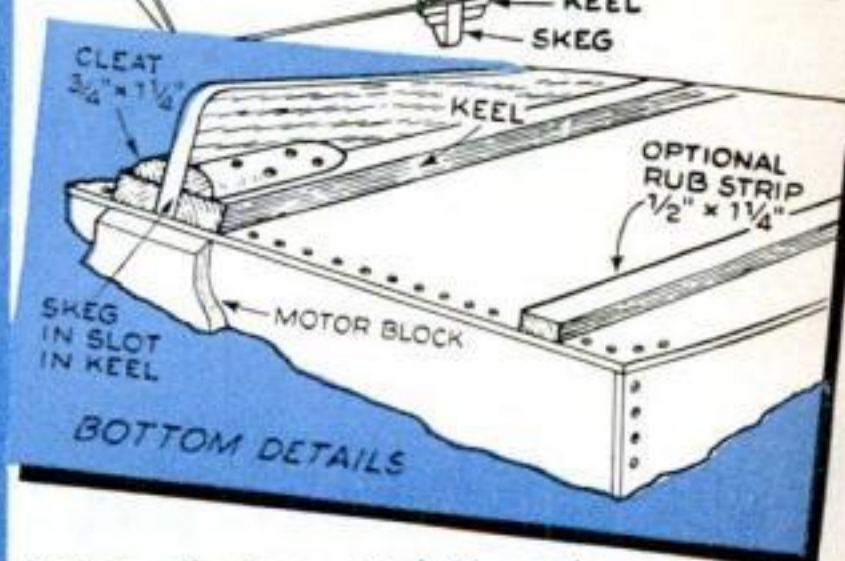
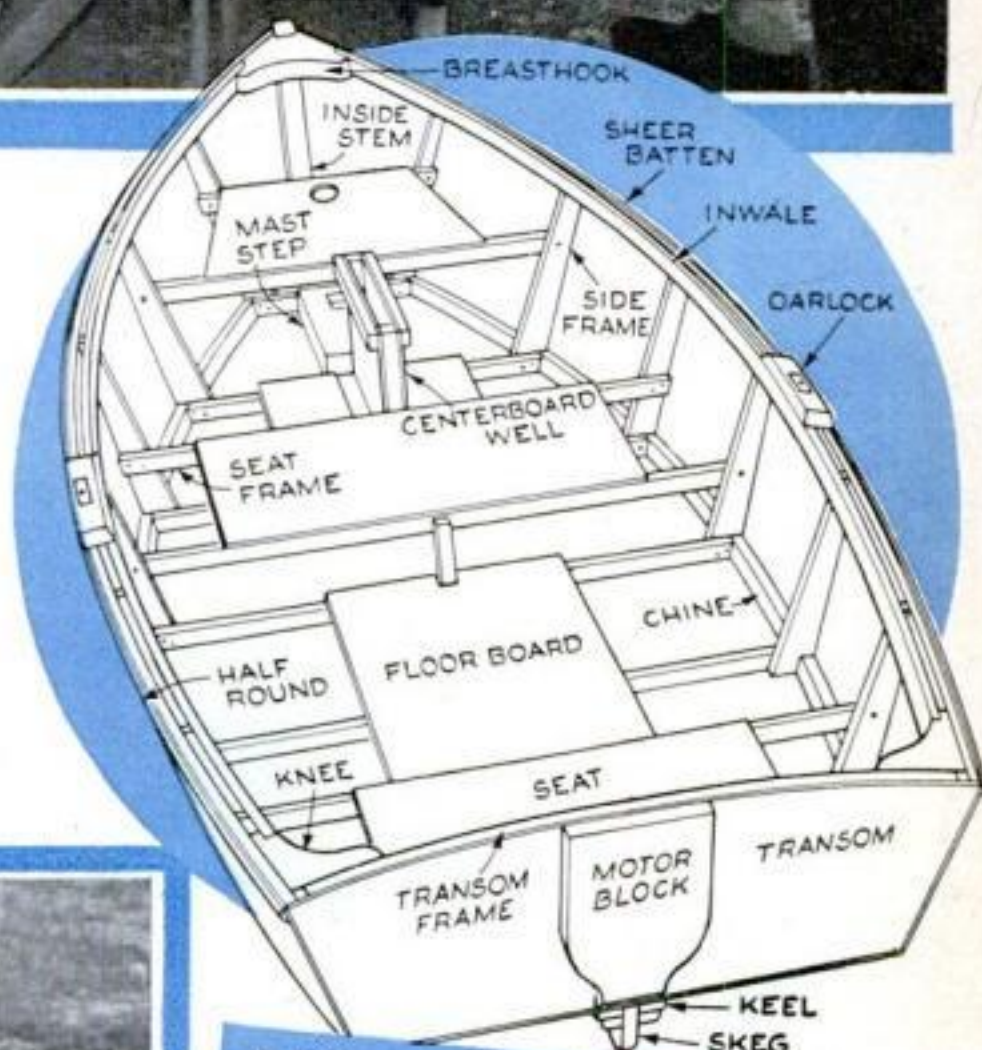
Inside view of bow.
At right, attaching
plywood planking



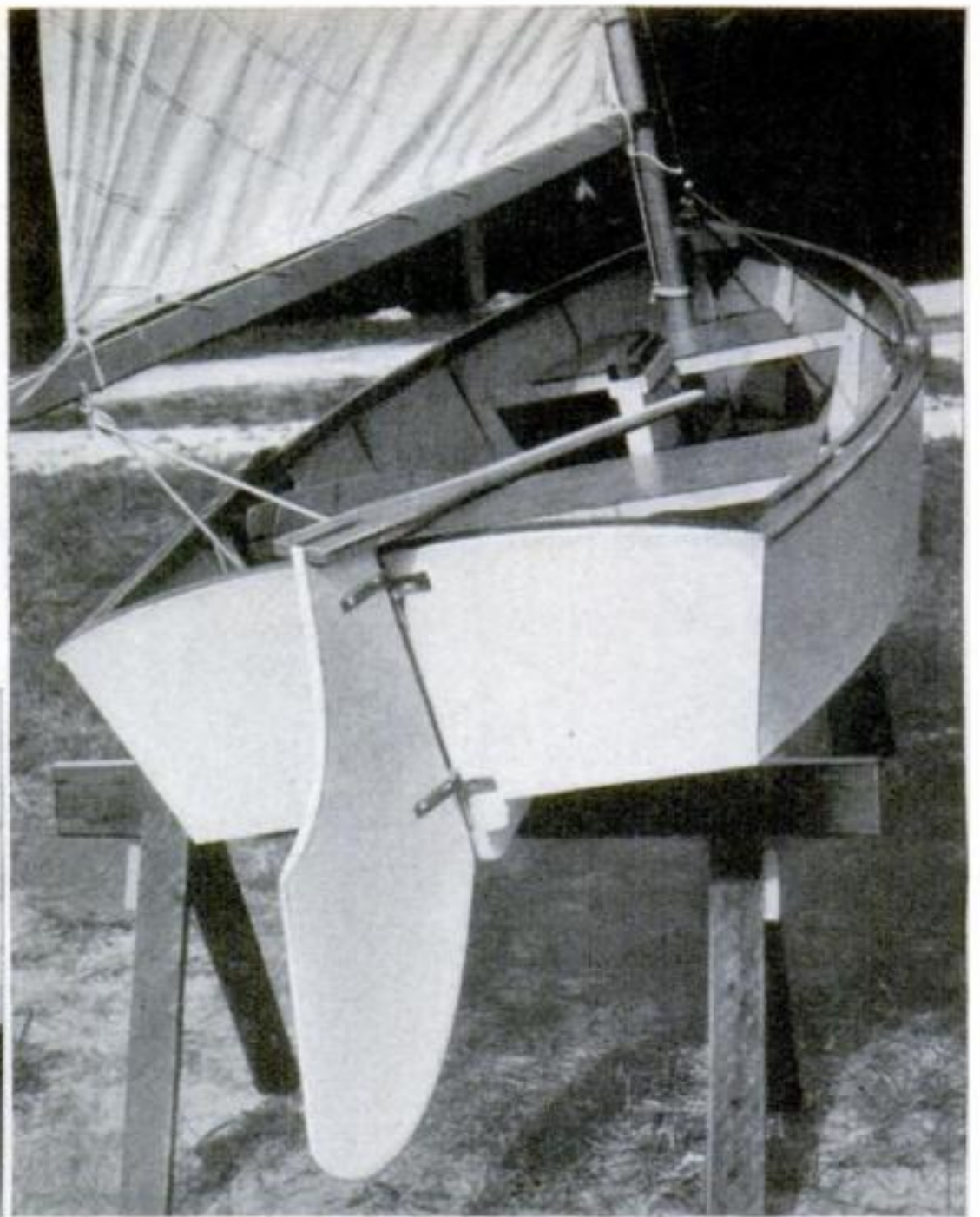
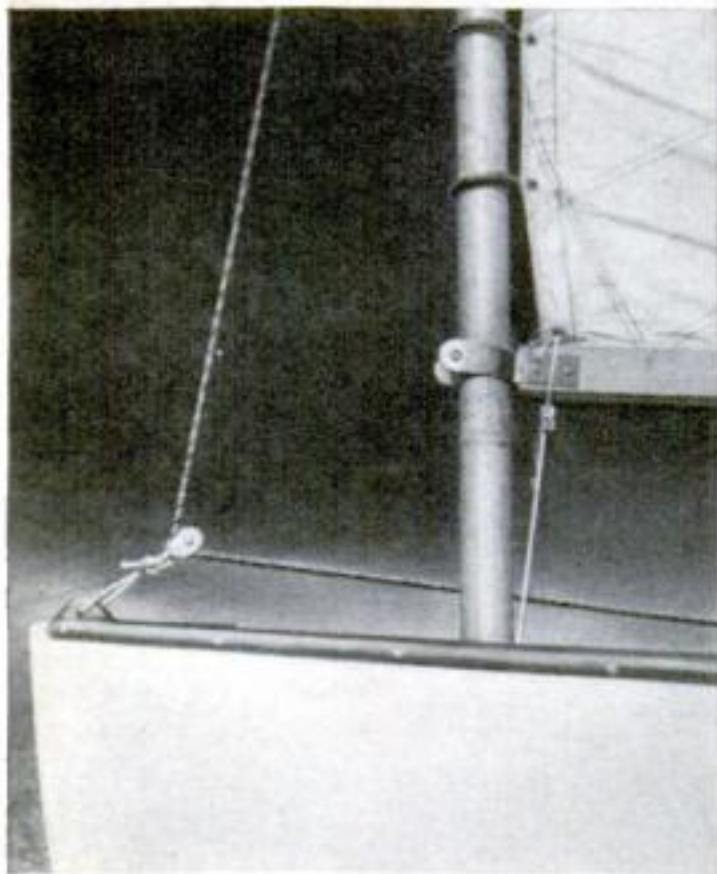
that they will not be hit when beveling the edges later. The planking should be fastened to the sheer batten with 1" nails clinched on the inside.

After the side planks are in place, they are planed down flush with the chines so that the bottom planking will fit perfectly. Next, coat the surface of the chines, transom, and stem with marine glue to insure a water-tight joint.

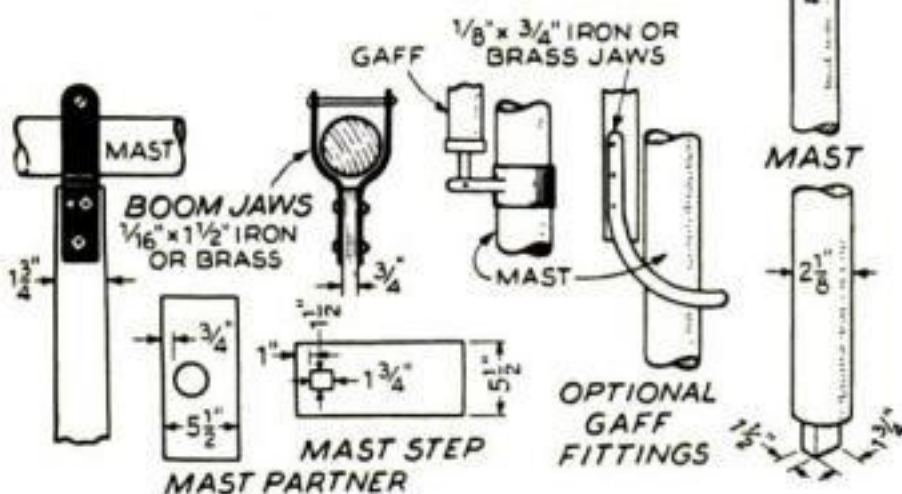
The bottom goes on in one piece and is fastened in the same manner as the side planking except that 1 1/4" screws can be used into the chines. After the bottom is fastened, the edges should be planed down all around, and then the keel and skeg fastened in place. A slot is cut in the keel for the skeg just up to frame No. 4; and the skeg is cut to fit the contour of the bottom. The skeg and keel are fastened to the frames with 2" No. 10 screws, and the skeg is also fastened from the inside, and with small cleats



Bottom of stern. At left, marking the bevel on the outside stem



Pintles and gudgeons hold the rudder in place. The rudder, centerboard, and mast can easily be removed



Sketches of the mast and its fittings. Note the mast hoops of plywood in the photo above

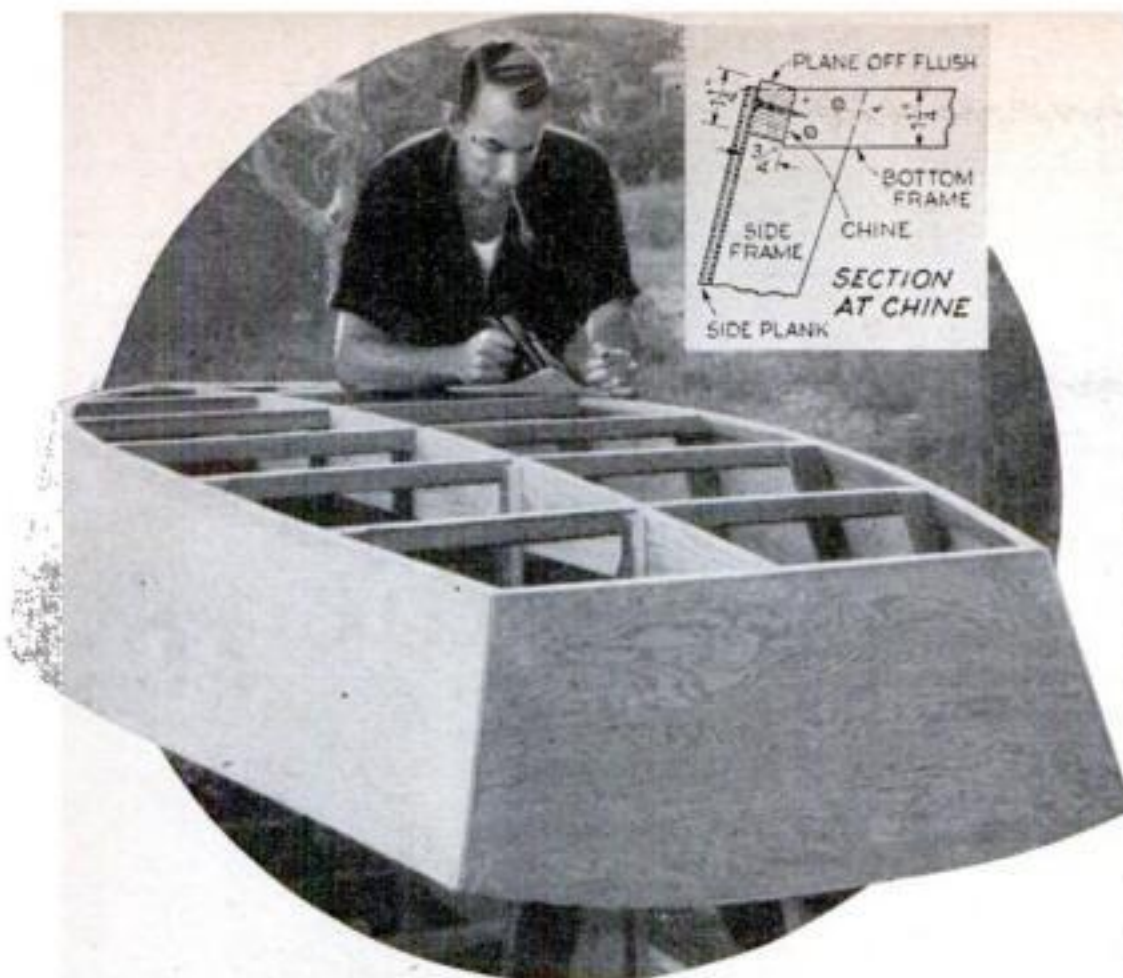
Dress the planking down at the bow so that the outside stem will fit over it. This joint should be made water-tight with a strip of cloth soaked with marine glue, and the outside stem screwed to the inner stem with 2" No. 10 screws.

Now the boat can be turned right side up, and the entire inside given a coat of paint before work is started on the seats and fittings. A special resin primer may be ob-

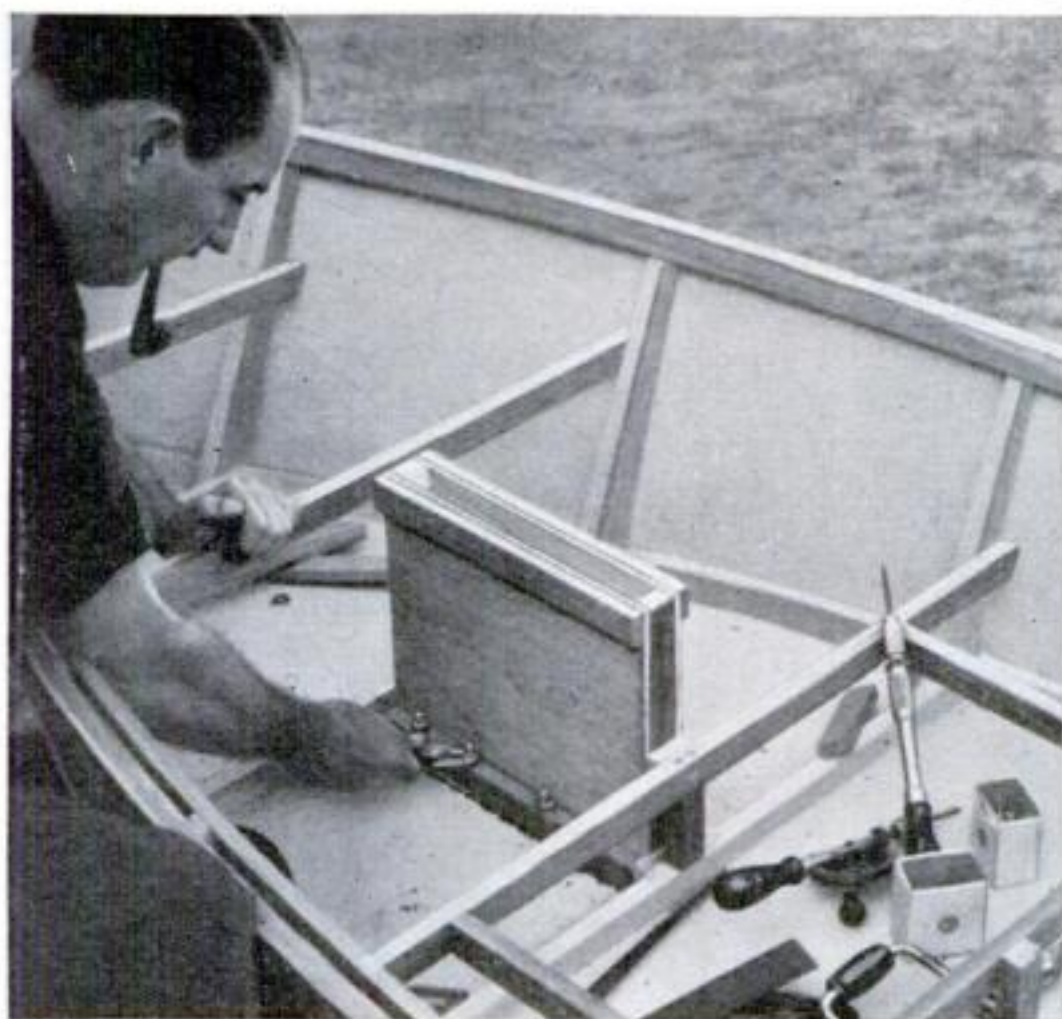
The breasthook and knees are next fitted in place and fastened through the sheer battens with 2" No. 10 screws, and notches are cut a little way into the frames for the inwales. The oarlocks are fastened to special blocks, which fasten to the inwales and sheer battens. The special framework for the seats is installed as shown, and the seats and floor boards made from left-over plywood.

After the sheer has been planed to an even curve, clamp the half-round molding into position and fasten it to the sheer battens with $\frac{7}{8}$ " No. 7 screws spaced about 4" apart.

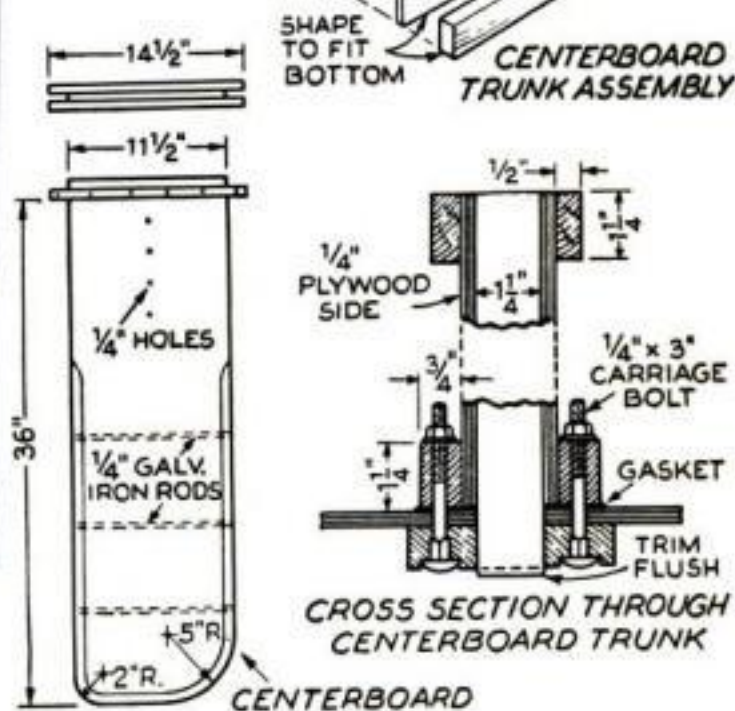
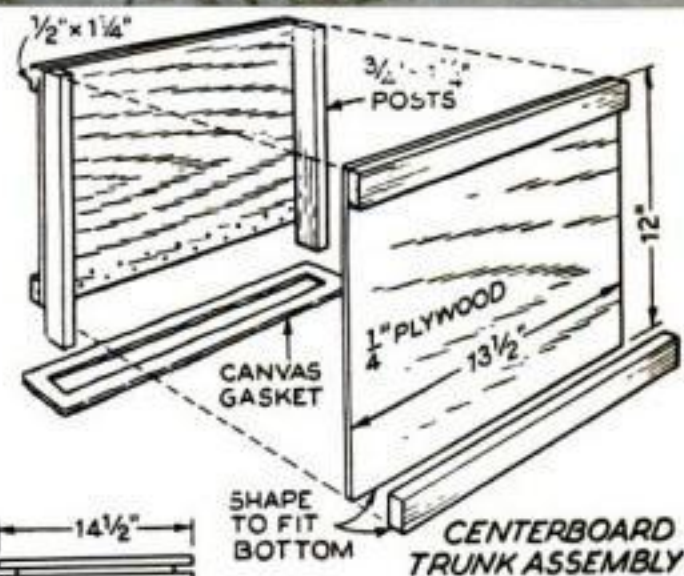
If the boat is to be used for sailing, the centerboard well should be made as in the drawings, and put together with plenty of screws and marine glue. A canvas gasket soaked with marine glue is used between the trunk and the bottom of the boat. The end pieces of the trunk should extend through the slot cut in the keel, to be sawed off later flush with the outside of the keel. The rudder, tiller, centerboard, and mast step and partner are cut out according to the



Side planks must be planed flush with the chines. Right, cutting out the slot for the centerboard



A gasket of canvas soaked in marine glue is placed between the centerboard trunk and the bottom of the boat



dimensions in the drawings. Screw the mast step to the keel with 2" No. 10 screws and fasten the partner to the framework of the front seat.

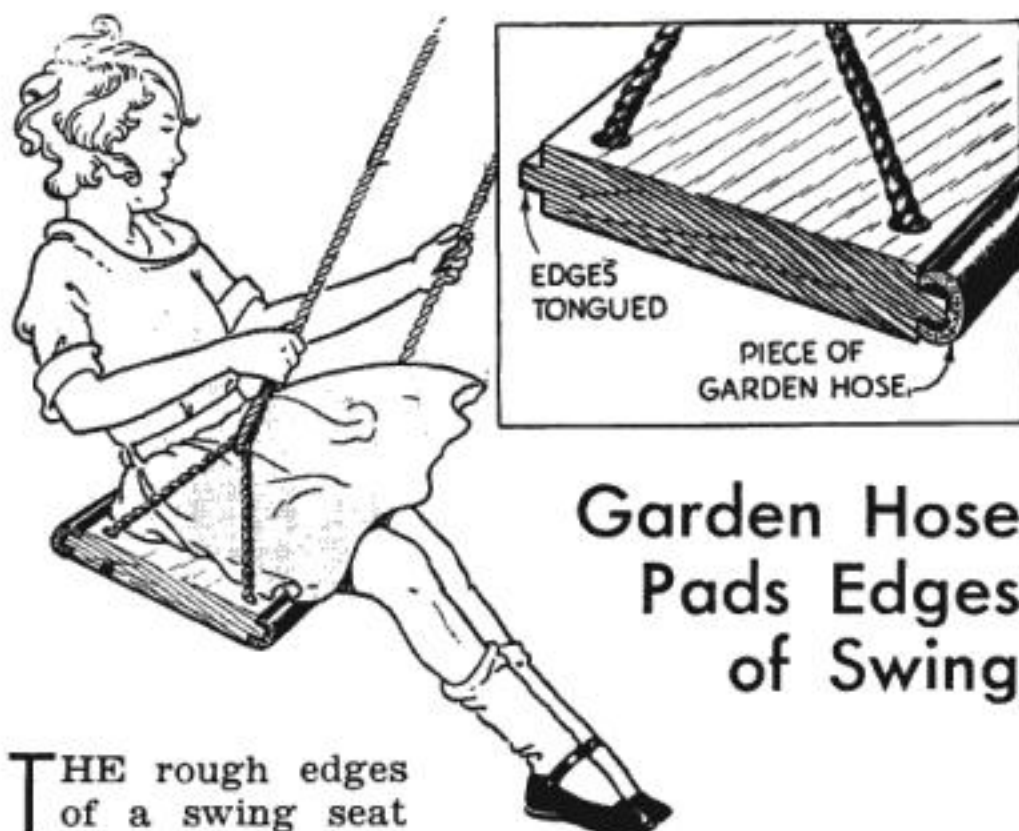
The mast, gaff, and boom should be of straight-grained spruce. Plane the mast and gaff to an octagonal shape before attempting to make them round. The mast is cut rectangular where it fits into the mast step, and a slot is cut at the top for the sheave.

The boom and gaff yokes can be made of strap iron or brass; or special fittings may be used instead, as desired. The halyard is $\frac{1}{4}$ " rope and acts as a forestay. No side

stays are needed, so the mast can be easily removed at any time. The sail is laced to the gaff and boom as shown in the sail plan, and the mast hoops may be cut from $\frac{3}{8}$ " or $\frac{1}{2}$ " plywood.

Rub strips can be added to protect the bottom if desired. The hull should have at least two coats of marine paint, followed with a coat of spar varnish to protect the finish.

If desired, the dinghy may be used with a small outboard of from $\frac{1}{2}$ to $1\frac{1}{2}$ h.p. A speed of approximately 4 to 6 m.p.h. can be obtained.



Garden Hose Pads Edges of Swing

THE rough edges of a swing seat won't cause scratches or tear children's clothing if padded with rubber as shown above. Cut tongues along each edge of the seat, then split a piece of old garden hose lengthwise, cut off two lengths, and tack them on securely.—DONALD S. PARKER.

Removing Old Shovel Handles

TO REMOVE wood left in the socket when a handle breaks off, take out the retaining pin, saw the wood off square, drive a heavy wood screw part way into the wood that remains, fasten the screw head in a vise, and drive off the socket with a blunt cold chisel.



Improved Pork Lures for Bait Casting

ONE of the first and deadliest bait-casting lures used in this country was the pork chunk. A modern improvement is shown below. It will take bass when other lures fail and is unexcelled for use among lily pads.

Pork chunks are best cut from the belly of the hog where the skin is softest. Your butcher will aid you in obtaining suitable pieces. The heavier portion of the fat is left on the rind in the forward part of the lure. This fat



tapers toward the two flexible "legs," which have a wiggling motion in the water. The lures are 1" or 1 1/4" in width and about 3" long. Insert an ice pick under the rind from one side to the other at the head of the lure and pass three strands of red yarn through. the pork lures can be preserved in a 10-percent solution of formaldehyde.—ROBERT PAGE LINCOLN.



Low-Cost Picnic Stoves Constructed from Discarded Ice Molds

OUTDOOR stoves for use at picnic grounds or in back yards may be made cheaply from discarded ice forms obtained from a local ice plant. If these tanks are not available, other containers, such as 50-gal. drums, may be cut in two and a flat top bolted on for the cooking surface.

In either case, four legs made of pipe or angle iron are required to raise the top to a height of about 34", or high enough to eliminate stooping. For public use, it is desirable to drive the posts into the ground to prevent the stoves from being moved, but for family use, it is more convenient to be able to turn the stove into the wind to help the draft. A length of stovepipe may be snipped and clinched through a hole cut in the rear top of the tank, as shown. These stoves have an unusually good draft, are easily fired, and heat quickly because of the thin metal.—DON R. FOSLER.

Lids of Candy-Bar Boxes Used as Display Racks

A FILLING-STATION manager makes economical racks upon which to display boxes of candy bars by utilizing the box covers as shown below. Triangular sections are cut out near one end, and the tops are folded back to form a trough, thus allowing the contents of the boxes to be displayed upon a counter or shelf at the best angle for customers to see.



Method of cutting top to support box

Match Scratches on Woodwork

MATCH scratches on woodwork can often be removed by rubbing them with a slice of lemon, then with whiting, and finally with a moist, soapy cloth.

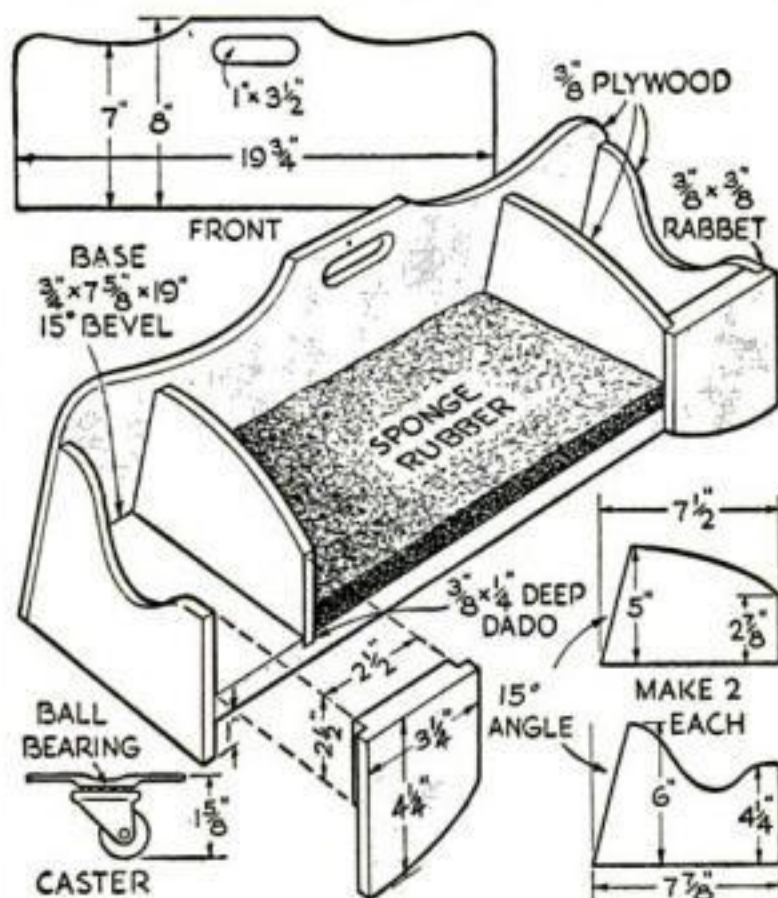
Metal Marked Legibly with Colored Lead

IN LAYING out work on metal, the disfiguring marks of a scribe can be avoided by use of a mechanical pencil with red or blue lead. The trick in using them is to moisten the tip immediately before drawing a mark, which will then be very legible. Do not, however, moisten the lead with the lips. If no longer needed, the lines may be removed easily with a damp cloth.



Kneeling Stand Is Aid in Waxing Floors

HOUSE-CLEANING tasks such as floor polishing and waxing are less tiresome when a kneeling stand is used. The one shown is equipped with rollers and has a compartment at each end to hold floor wax, cleaners, and rubbing cloths. The slanting front protects clothing from being splashed by liquids. The center part can be covered with cloth pads or a $\frac{1}{2}$ " thick sponge-rubber mat. In assembling the stand, glue and nail all joints for added strength. The four small casters should be of a type equipped with hard-rubber wheels. Finish the stand by painting to suit.



Floor wax and rubbing cloths are stored in the compartments; the center part is padded

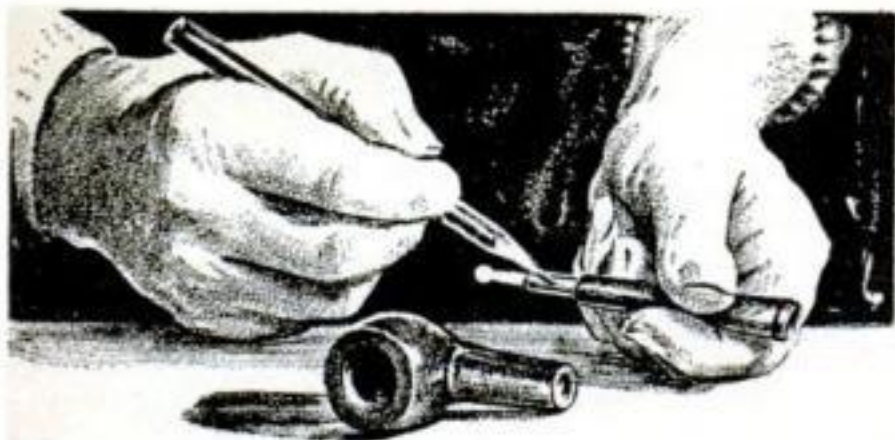


Fine Water Spray Allays Dust in Room Before Painting

AMATEUR painters are often advised to dampen the walls and floors of their workshops before attempting to enamel or varnish any furniture or other work. For this purpose I use a hand spray filled with water. I first spray the floor all around the area where I'm varnishing. Then I point the spray up in the air and spray the air throughout. This has the effect of washing the air. A very fine spray should be used.—T. G. HETRICK.

Lead Pencil Lubricates Tight Stem of Pipe

PIPE stems of the type that are merely pushed into place often fit very tightly, and the shank of the pipe may be cracked in forcing the stem back after the pipe has been cleaned. To lubricate the stem so this won't be so likely to happen, rub lead from a soft lead pencil all around the small diameter of the stem as shown below.



After applying a coating of graphite, the pipe is easily reassembled with a slight turning motion



Sawdust Separates Dross from Molten Lead

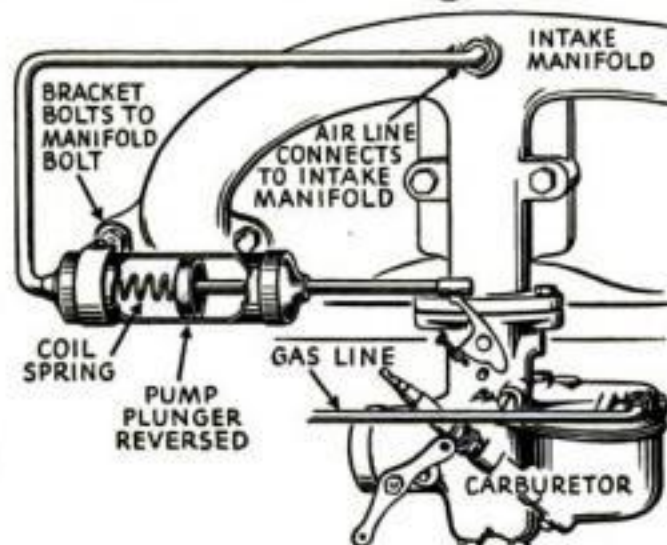
A FACTORY where tons of lead are melted every day uses ordinary sawdust to help separate the dross from the pure metal. The sawdust is simply dumped into the melted lead and stirred through it. Of course, the wood particles burn, but the resulting ash is skimmed off with the dross. It seems to make no difference what kind of wood is used for this.

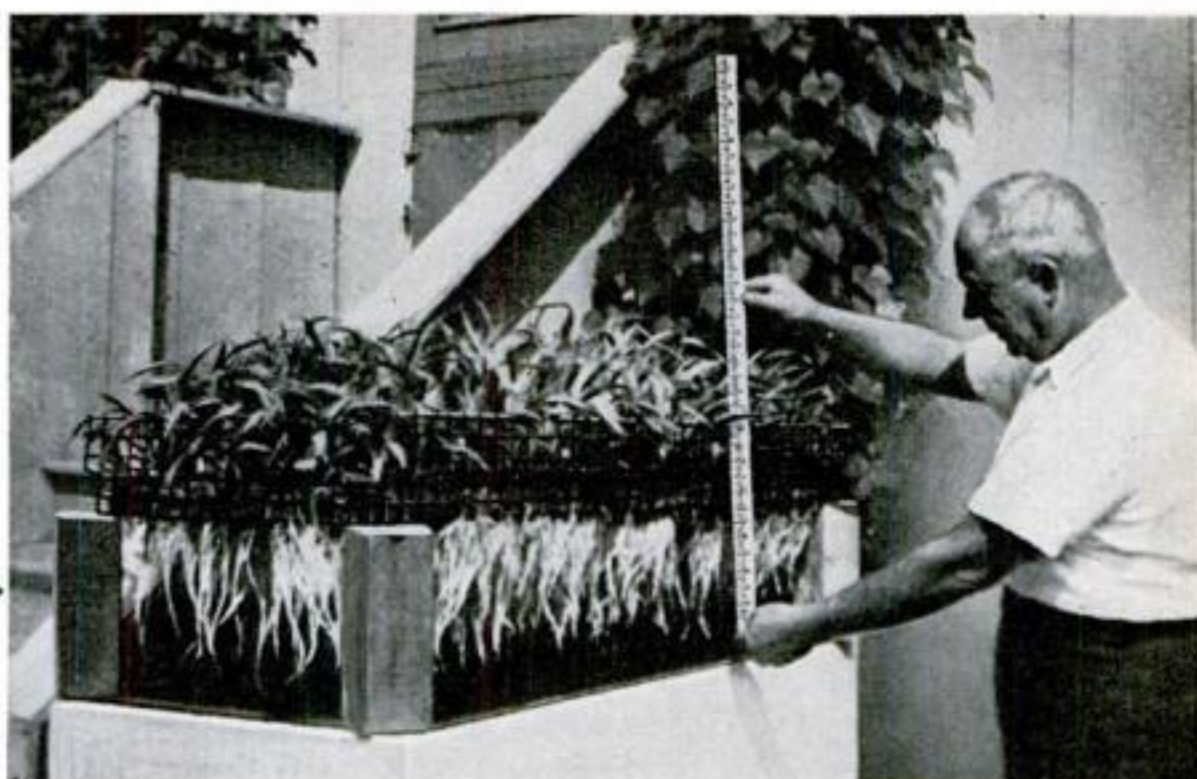
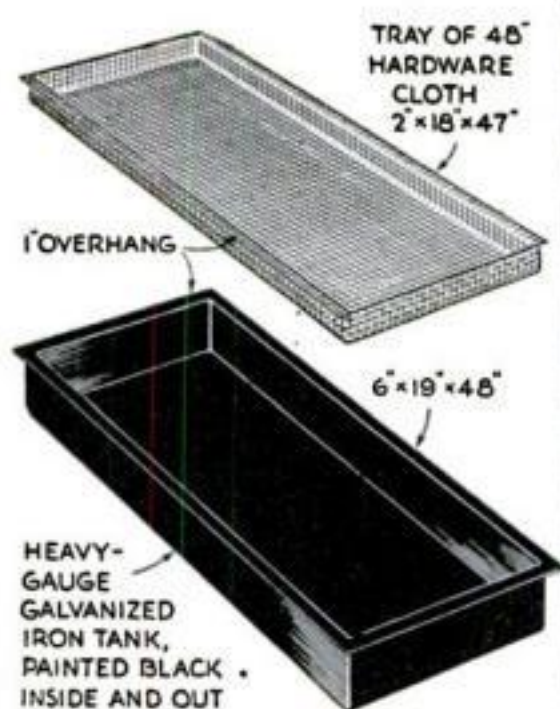
For the average home-workshop melt of a few pounds of metal, a tablespoonful of sawdust is about the right amount, I have found. The dross can be pushed to one side and scooped out with an old spoon.—W.E.B.

Old Grease Gun Used as Governor for Engine

THE speed of an automobile engine used as a stationary power plant can be controlled by a governor made as shown in the diagram at the right. I used an old grease gun and replaced the cork plunger with a pump leather.

As the engine is pulled down and begins to run slower, the vacuum in the cylinder is reduced and the coil spring opens the throttle. The changes in the vacuum in the manifold therefore maintain an even speed. By loosening a bolt on the mounting bracket, the engine speed can be adjusted to any desired point to suit the power requirements.—CHARLES VAN HOYE.





Fodder Farming

WITHOUT SOIL

An 18" by 48" tray showing results of planting 1 lb. of corn seed, or what is usually grown in a 400' field row

ONE of the most valuable functions of plant chemiculture or tank farming is that of producing well-mineralized, nutritious green fodder for animals and poultry.

Forage may be grown the year around, and the growth will average about 1" a day in a favorable temperature. The entire plant—roots, kernel, and leaves—may be pulled up and fed, or the poultry or animals may be allowed to feed right at the tank if a chicken-wire guard is built on a rack above the seeds to prevent the kernels from being torn up.

To try this method in the simplest way, make two small experimental tanks by cutting a 5-gal. gasoline tin in half. Paint the metal black, inside and out. Build a suitable wooden box to hold the tanks, and make 2" deep trays to fit them from hardware cloth (wire mesh) of from $\frac{1}{4}$ " to $\frac{3}{4}$ " mesh.

For a larger installation, have heavy galvanized-iron tanks made as shown, although the size can vary. It is best to have them about 6" deep. They should be painted black. Wooden boxes are then constructed to

hold them, and wire trays made to fit. If the mesh is larger than $\frac{1}{4}$ ", spread a very thin layer of shredded corn stalks, excelsior, or similar material on top.

Heat can be applied most efficiently with an aquarium-type, glass-inclosed heater and thermostat, obtainable from any dealer in aquarium supplies. A small thermometer floats in the solution, and the thermostat is set to cut off the current when the solution is about 70 or 75 deg. F.

The solution is mixed as shown in the accompanying formula. The kernels are flooded for about twenty-four hours; then the solution is lowered to a level just below them. The seeds are covered, and the covering is kept damp during the short time required for the roots to reach down into the

solution. The uptake of liquid by the corn is very great, so replace it with fresh solution of the same strength. We change the solution completely every two months and use the old solution around garden plants or trees.

It is also necessary to make frequent additions of a little iron solution. This is prepared by dissolving 2 tablespoons of lump ferric chloride in 1 gal. water. Without iron, the vegetation will become almost white in appearance.—C. D. DAWSON.

SOLUTION FOR GROWING CORN

Calcium nitrate	1.5 ounces (4 tablespoons)
Ammonium nitrate	2.25 ounces (8 tablespoons)
Sodium phosphate	0.5 ounces (2.5 tablespoons)
Potassium chloride	0.4 ounces (1 tablespoon)
Magnesium sulphate	0.4 ounces (2 tablespoons)
Potassium iodide	5 grains
Boric acid (crystals)	1 grain
Manganese sulphate	1 grain
Zinc sulphate	1 grain

Weights are avoirdupois. Spoon measurements are not as accurate, but will serve. Add the chemicals to 25 gal. tap water.



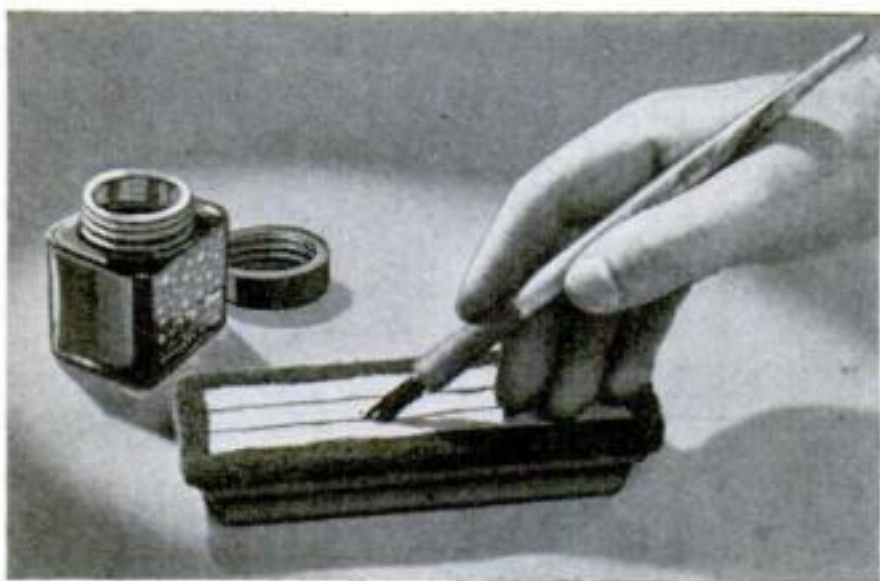
Either mineral oil or vegetable shortening will take paint off readily

Cleaning Painty Hands Without Turpentine

ORDINARY vegetable shortening, found in almost every refrigerator, or mineral oil from the medicine cabinet are excellent for removing paint from the hands. They can be used when no turpentine is available; in fact, they have one marked advantage over turpentine in that the latter has a strong odor that clings to the hands and is difficult to wash off.—ALLEN JAMIESON.

Blackboard Eraser Acts as a Penwiper

AN ORDINARY ten-cent blackboard eraser is an efficient penwiper that will last for years. It may be placed on a desk beside the ink bottle or screwed to the top of an artist's or draftsman's drawing board. Drawing any type of pen between two of the sections of the thick felt will cause all of the ink to be absorbed quickly.



The pen is cleaned by drawing the point between two sections of the felt-covered blackboard eraser

Plastic Handles Fitted by Using Hot Water

HANDLES made of cast resinoid plastic are best fitted to knives and other implements by the hot-water method. The hole in the handle is made a few thousandths of an inch smaller than the shank of the part

to be inserted. Then the handle is immersed in hot water (about 200 deg. F.) until the plastic softens and expands. The shank is forced into the hole and held firmly while the plastic cools and shrinks.

When an old handle on a knife becomes loose, the shank usually can be built up with solder to make it larger, and the handle refitted as described.



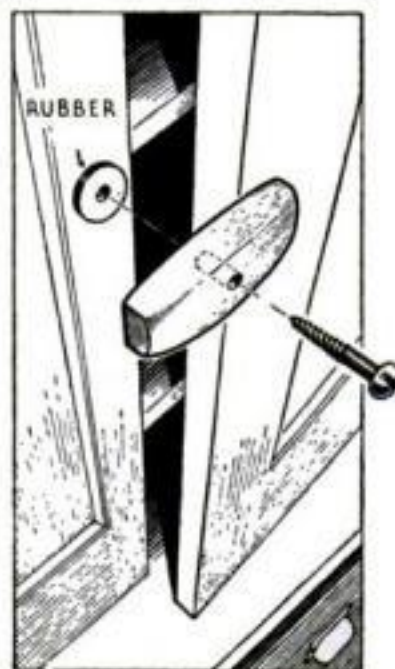
Cement-Tube Stopper Turned with Crank



TUBES of quick-drying cellulose cement or liquid solder can be closed more conveniently and rapidly if the screw plug, which is usually diamond-shaped, is twisted into the form of a crank with pliers. It is spun around to open or close the tube.

Rubber Washer Keeps Turn Button Tight

WHEN a wooden turn button is used instead of a latch for a gate or door, you can insure against its opening accidentally by placing a disk or washer of rubber between the button and the woodwork. This will supply the necessary friction without having to drive the nail or screw in very tightly and readjust it at intervals.



Flexible Cement Seals Joints Around a Sink

TO SEAL the joints between a built-in kitchen sink and the linoleum-covered working top of the wooden kitchen cabinet in which it was set, various so-called "water-proof" cements and compounds were used, but all broke down sooner or later. This homemade mixture then proved successful: 3 oz. plumber's pitch, 1 oz. paraffin, and ten drops of castor oil, placed in a can and heated until thoroughly mixed.

The linoleum was peeled back enough to allow thorough cleaning of the sink edges and woodwork with a wire brush, steel wool, and gasoline. (CAUTION: See that there is no open flame, and keep doors and windows open.) The warm cement was then poured directly on the woodwork and the sink edges so that all cracks were well filled, and the linoleum was ironed slowly back into place with a moderately hot iron. Cold water was sponged over the job, and the surplus pitch wiped off with a cloth slightly dampened with gasoline.

The advantages of this compound lie in the strong adhesive properties of pitch, the

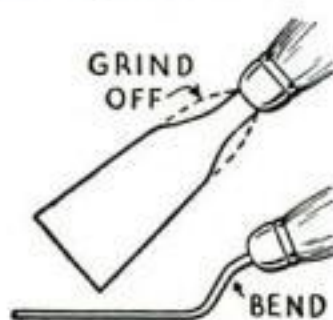


lowered working temperature resulting from the paraffin, and the flexibility obtained by adding castor oil.—J. E. GUY.



Small Trowel for Patching Plaster Walls

SMALL, flat-nosed patching trowels are rather expensive, but decorators and electricians can make a good substitute from a ten-cent putty knife. Clamp the blade in the vise and drive off the handle. If the steel is of fair quality, it will ring when thumped with the finger. In this case, heat the butt to a very dull red and let it cool slowly. Grind or file a portion away as shown, bend the blade to a suitable angle, reheat to a cherry red, and immerse it in any kind of oil. If you don't heat it too hot, you may cool it in water instead. Then drive on the handle.—J. H. DUNNEWIN.



Hook Helps in Pulling Paper Bag over Suit

A WIRE coat hanger bent as shown at the right below will aid in the awkward task of pulling a paper bag over a suit. The bag is first slipped on this hook. The hanger with the suit is then placed on the hook, and the bag is slipped down into place over the garment.—ERIC D. LANE.

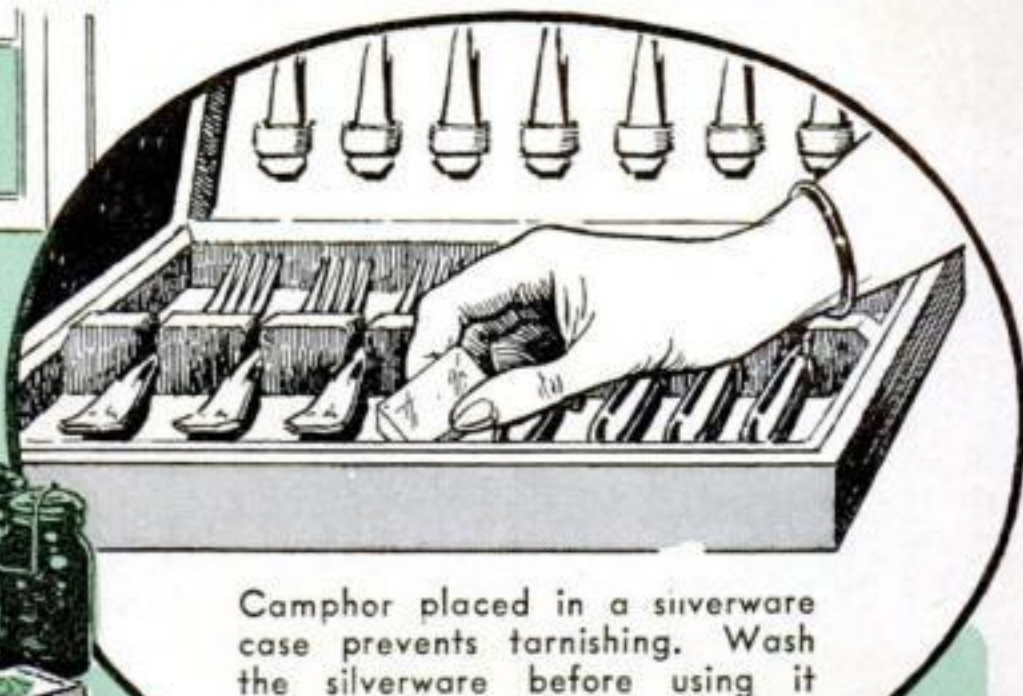


Once the bag has been slipped over the long wire hook, it can easily be pulled down over the suit

KEEPING THE



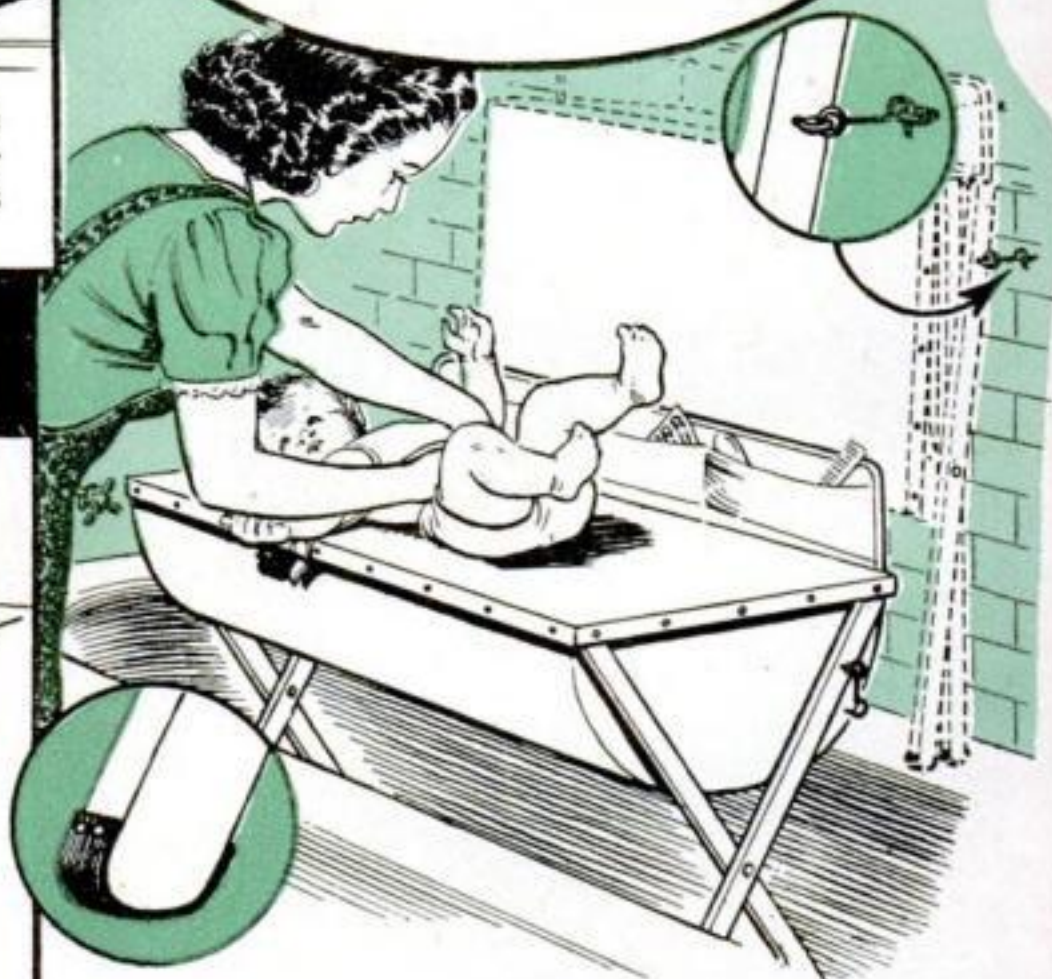
A flat-type, 5-gal. oil can may be made into a canner. Cut out the top and solder metal over the spout opening. Make a grill of wood strips



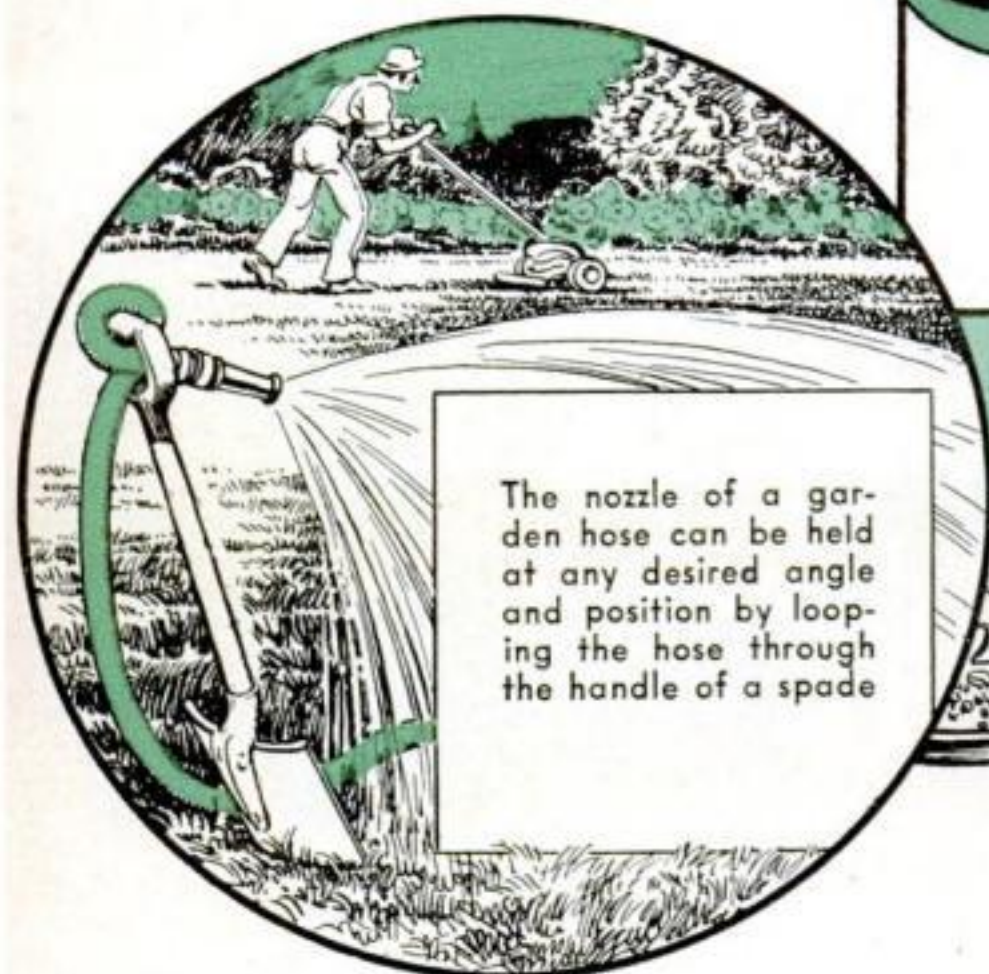
Camphor placed in a silverware case prevents tarnishing. Wash the silverware before using it



To remove starch caked on an iron, rub it over a sheet of fine sandpaper several times



Rubber tacked to legs of baby's folding bath will keep it from slipping in bathtub. Hooks and eyes hold the folded stand securely against the wall

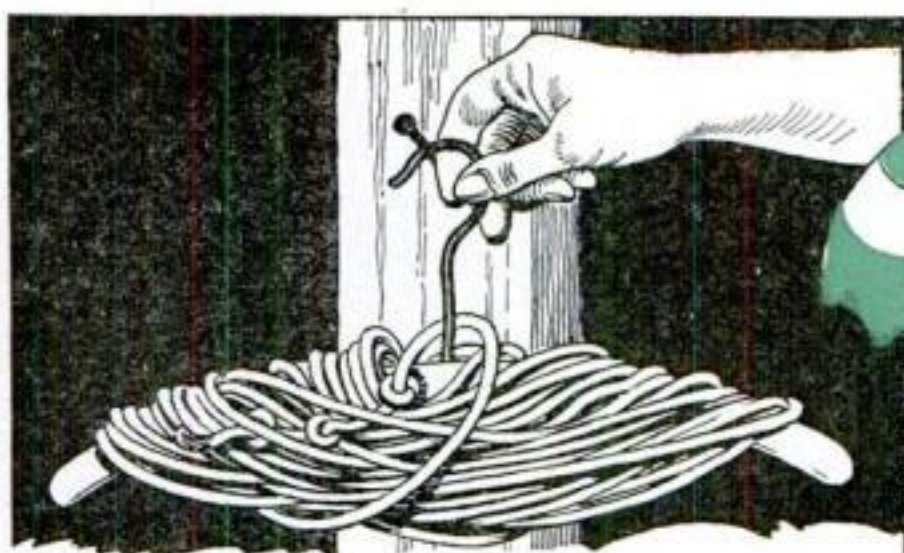


The nozzle of a garden hose can be held at any desired angle and position by looping the hose through the handle of a spade



Broken glass can be picked up without danger with the aid of absorbent cotton. Dampen the cotton and press it over the fragments, which will adhere

HOME SHIPSHAPE



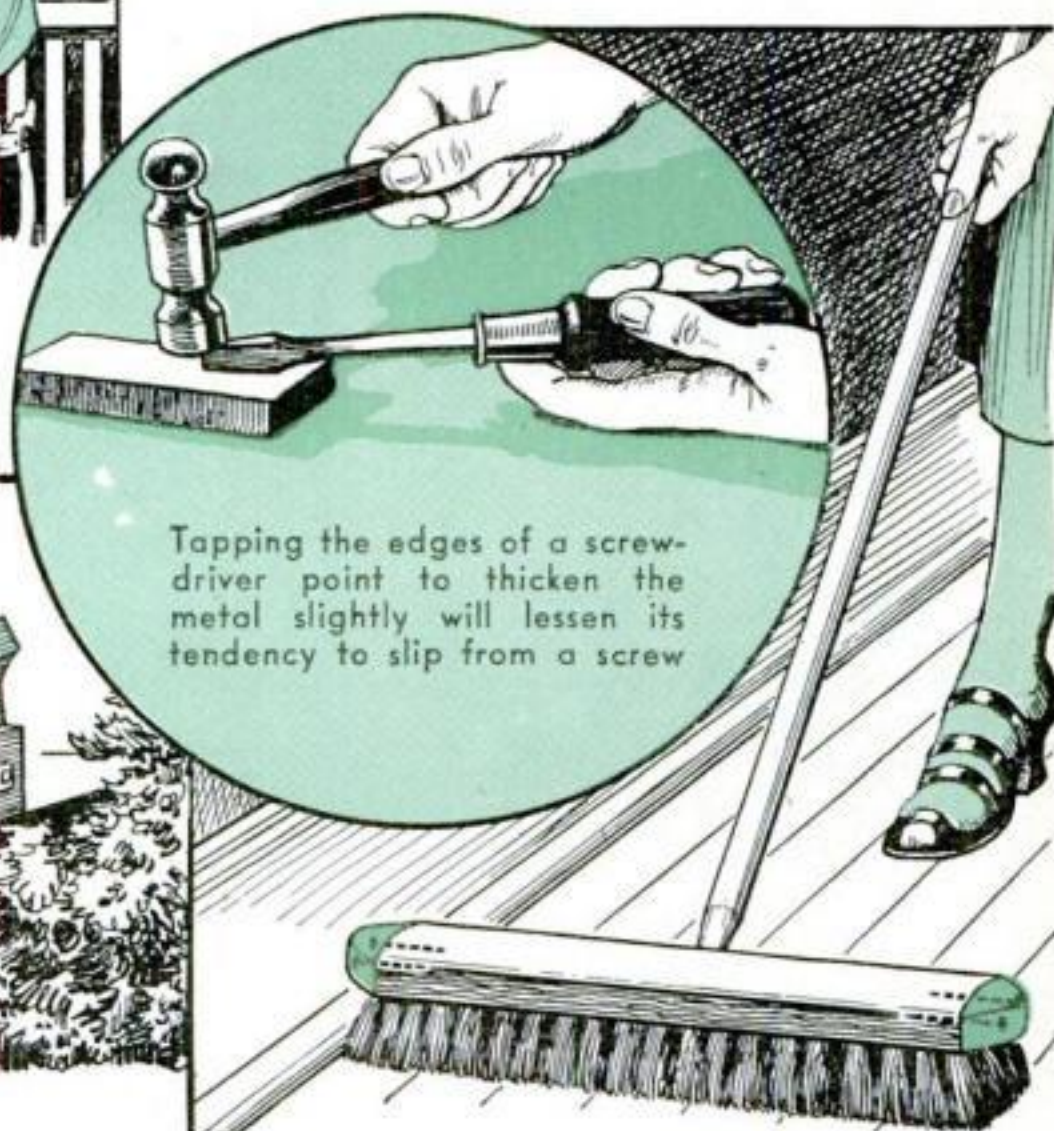
A coat hanger with a wooden crossbar is a good clothesline reel. Wind with a figure-8 movement



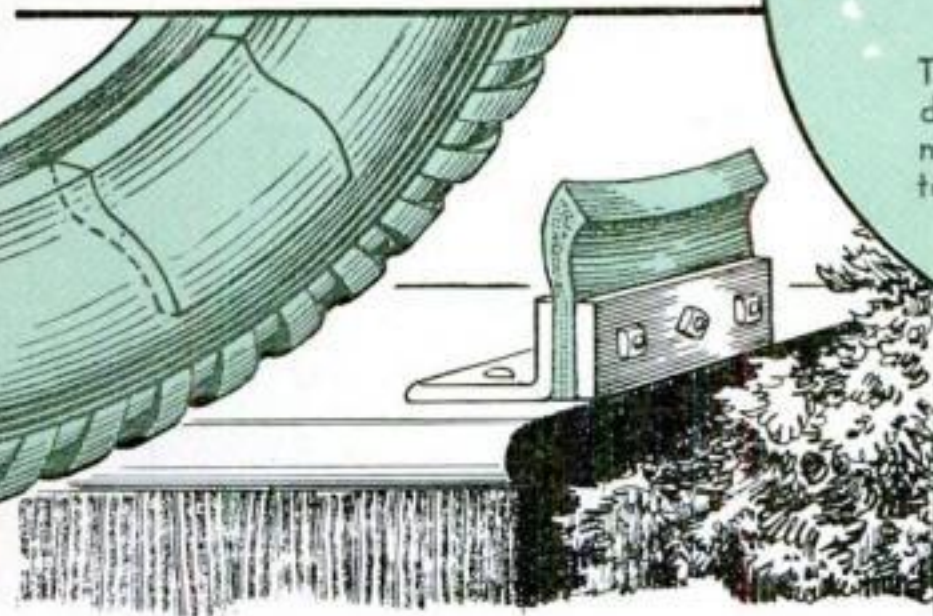
A lunch cloth for an umbrella table can be made by slitting the cloth halfway across and cutting a small hole in the center. Hem along the slit. Arrange several dishes to hold the lap in place



Held with a spring paper clip, a windshield-wiper blade can be used to remove water from French windows after washing



Tapping the edges of a screwdriver point to thicken the metal slightly will lessen its tendency to slip from a screw



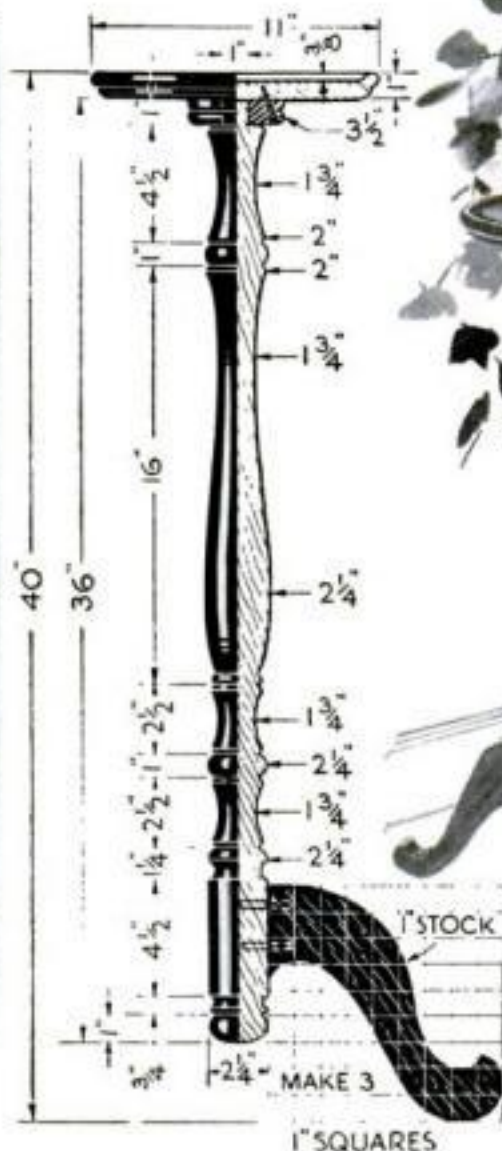
A section cut from an old auto tire makes an excellent foot scraper when supported and fastened to the edge of a step or porch with metal plates

To prevent marring baseboards when using a floor brush, attach pieces of rubber heel on ends

Ornamental Turned Stand Holds Pot of Ivy



Clamps are not essential in gluing the legs to the upright if holes are bored correctly



Attractive in design,
the piece looks well
wherever it is placed

PEDESTAL ivy stands are very popular. This one is made of walnut and will fit in with practically any type of furniture. The materials cost \$2.25.

The upright is turned from a piece $2\frac{1}{2}$ " by $2\frac{1}{2}$ " by 36". A 1" by 1" dowel is turned on the upper end and inserted in a 1" diameter hole bored in a 1" by $3\frac{1}{2}$ " turned piece. This in turn is screwed to the top with $1\frac{1}{2}$ " screws through the same holes drilled for the

faceplate screws when the piece was turned.

The turned top preferably should be built up of two or three pieces to minimize warping. The legs are cut on the band saw or scroll saw. On the original stand, the legs are beaded, but any attractive treatment may be used.

A finish of varnish or clear lacquer, well rubbed down, will enhance the beauty of this piece.—FRANK HEGEMEYER.

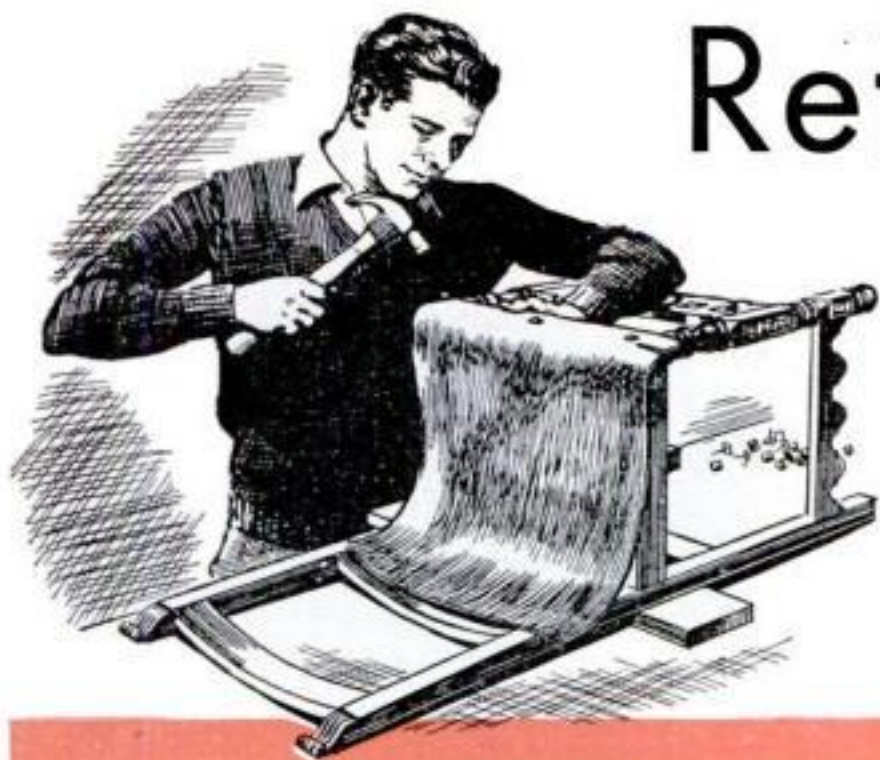
Scroll-Saw Table Prevented from Turning

THE aluminum disk or insert on a modern scroll saw can be kept from turning by drilling a small hole to the rear of the disk opening and inserting a finishing nail as shown at the right. The nail is cut off underneath, and the slot or disk placed over the nail head. If the disk cannot turn, it eliminates one common cause of broken blades.



Repairing Leaky Garden Hose

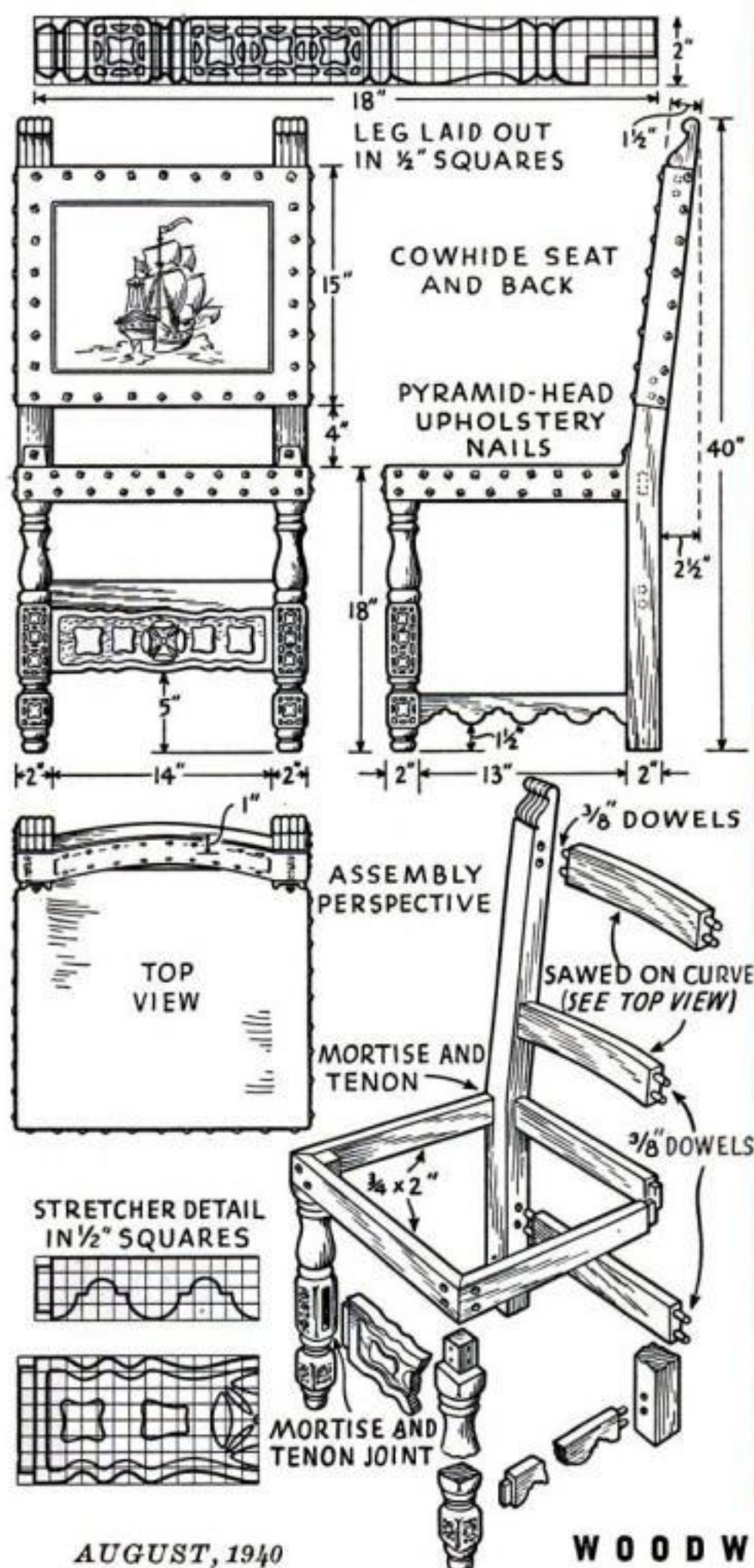
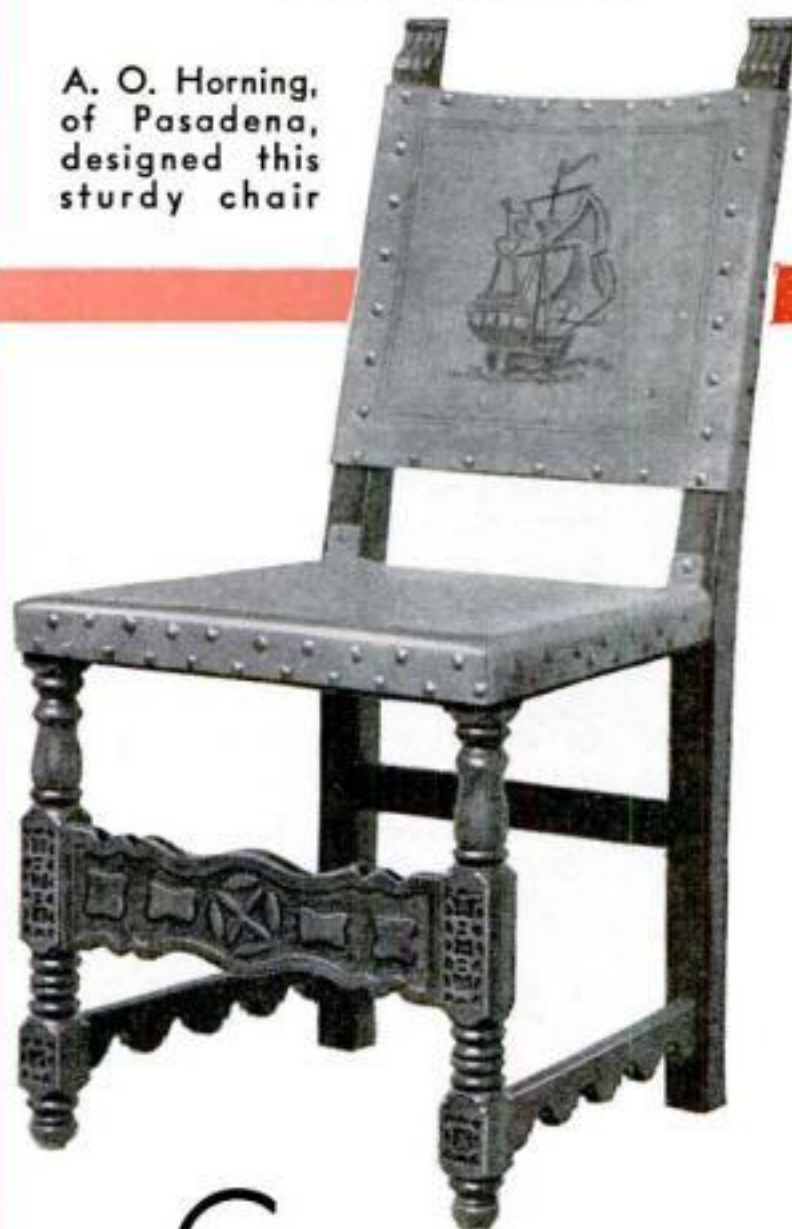
A SPLIT garden hose may be repaired quickly and permanently by using the new type of flexible casein cement. Dry the surface and spread glue over the split and at least 1" beyond each end. After the glue becomes tacky, wrap on two layers of friction tape. Give ample time for the cement to dry.—T.C.H.



Refectory Chair

OF SIMPLE DESIGN
IN MAHOGANY AND
COWHIDE

A. O. Horning,
of Pasadena,
designed this
sturdy chair



CHAIRS are usually quite difficult to build, but this substantial, refectory-style chair is designed along simple lines and all joints are at right angles except those in the back. Tabasco (Mexican) mahogany was used for the original chair, but walnut or other woods are equally appropriate. Note that all dimensions in the list of materials on the following page are net; specify this in ordering your lumber.

The front legs are turned and have hand-carved panels. The carving is of a type even a beginner can duplicate without difficulty. The rear legs are sawed from 2" by 5" material.

Mortise-and-tenon joints are used where greatest strength is required, and doweled joints elsewhere, as indicated. Take care that all joints are a driving fit and well glued. The screws used in the front legs at the seat are concealed by the cowhide covering.

Stain and fill the wood and apply

LIST OF MATERIALS

No. Pc.	Description	T.	W.	L.
1	Back legs	2	5	40
2	Front legs	2	2	18
1	Back cross members	2	2	15
1	Seat rails	$\frac{3}{4}$	2	70
1	Lower front rail	$\frac{3}{4}$	4	15
1	Side rails	$\frac{3}{4}$	2	28
1	Back rail	$\frac{3}{4}$	1 $\frac{1}{2}$	15

1 pc. cowhide 21" by 22" for seat; 1 pc. cowhide 16" by 22" for back; 1 gross pyramid or squarehead upholstery nails; $\frac{3}{8}$ " dowels; screws; casein glue; finishing materials, etc.

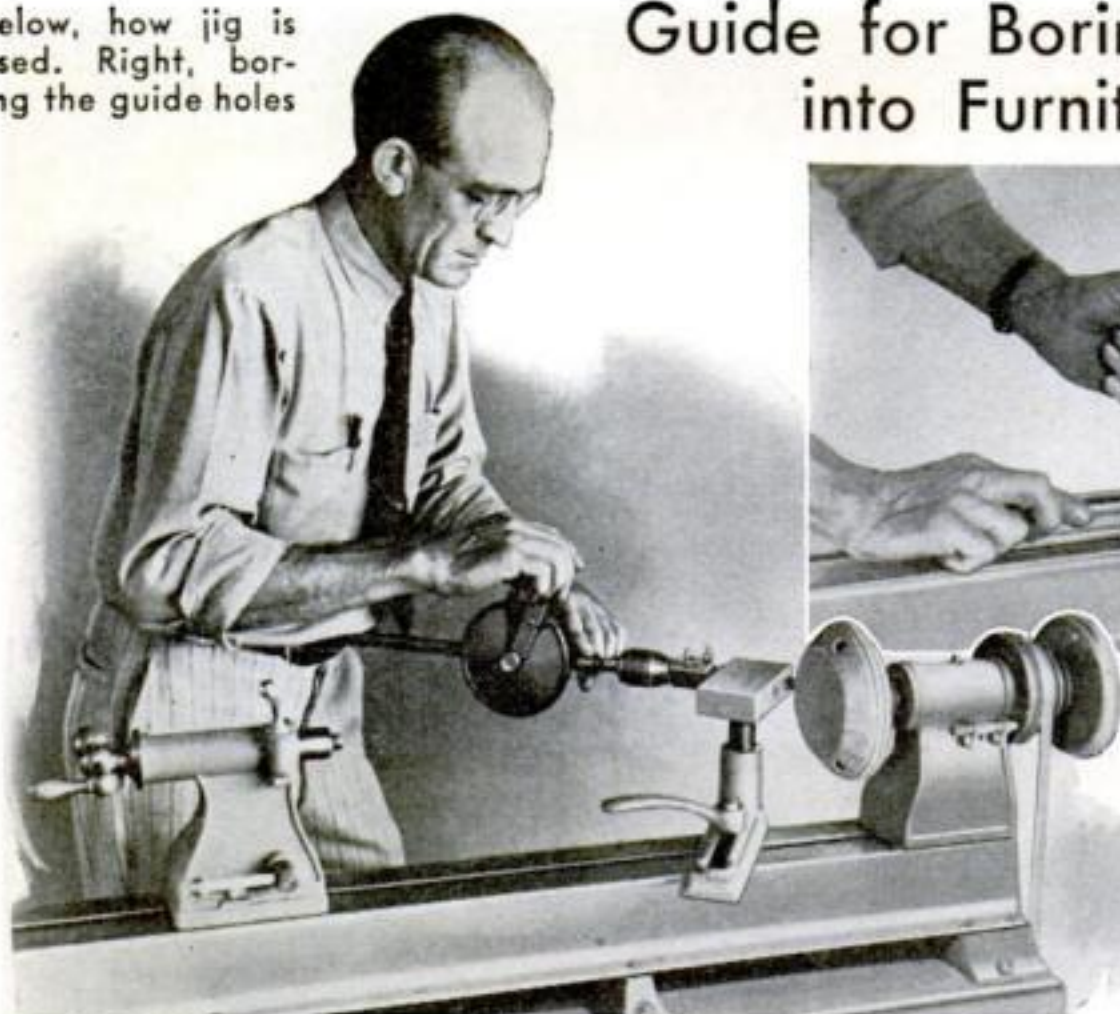
NOTE: All dimensions are given in inches.

either a shellac-and-wax or a first-class hand-rubbed varnish finish. The cowhide on the back can be ornamented with the design shown or some other of your own selection. This can be tooled into the damp leather with leather-craft modelers, or burned in with a pyrographic outfit.

Davit Sockets for Ship Models

HOLLOW brass rivets can be used for davit deck sockets on ship models. Drill a small hole through the head and fasten the rivet bottom up with a pin.—PAUL H. SMITH.

Below, how jig is used. Right, boring the guide holes

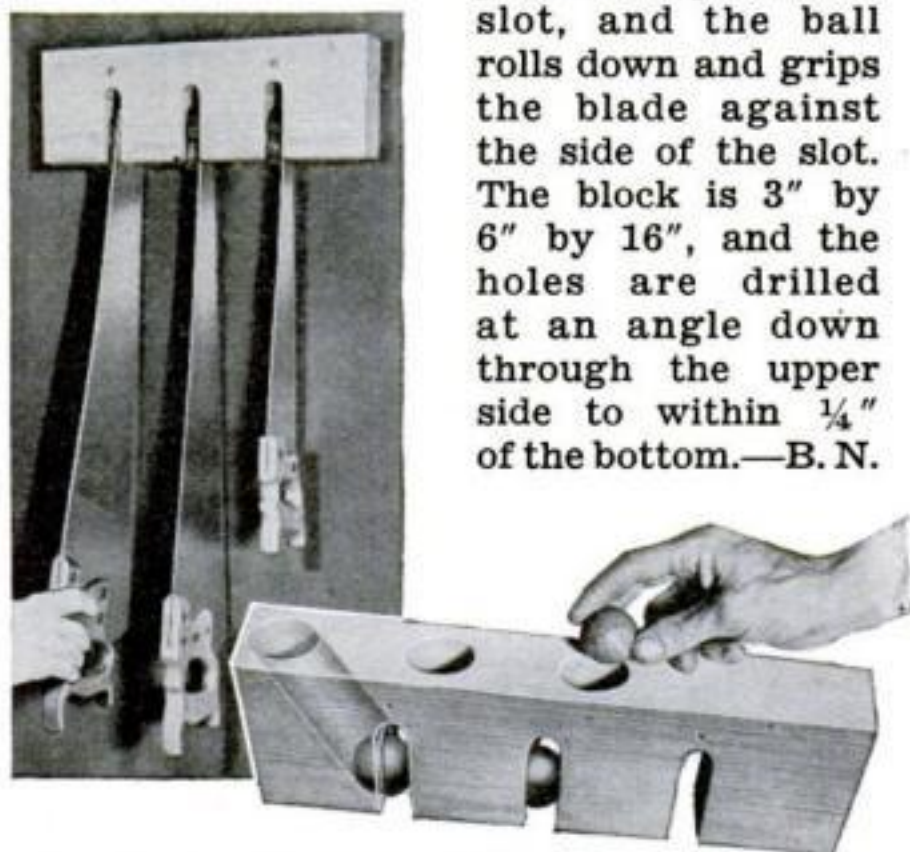


DESIGNED for use with a wood lathe having an indexing head, the jig illustrated enables holes for legs to be bored accurately into the base members of Colonial table lamps, tilt-top tables, pedestal stands, and the like.

Rubber Balls Hold Saws in Quick-Acting Rack

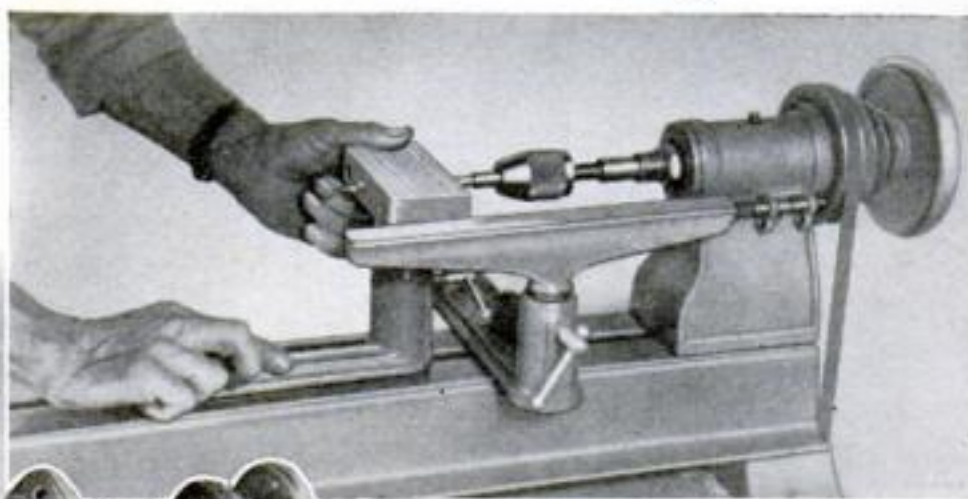
ONLY one motion is needed in hanging up or removing a saw from this rack, and it is unnecessary to touch the blade. The saws are held in place by solid rubber balls of the type made for float valves and obtainable at hardware stores. The saw is simply

pushed up in the slot, and the ball rolls down and grips the blade against the side of the slot. The block is 3" by 6" by 16", and the holes are drilled at an angle down through the upper side to within $\frac{1}{4}$ " of the bottom.—B. N.



A rubber ball is dropped into each of the holes

Guide for Boring Holes on Slant into Furniture Turnings

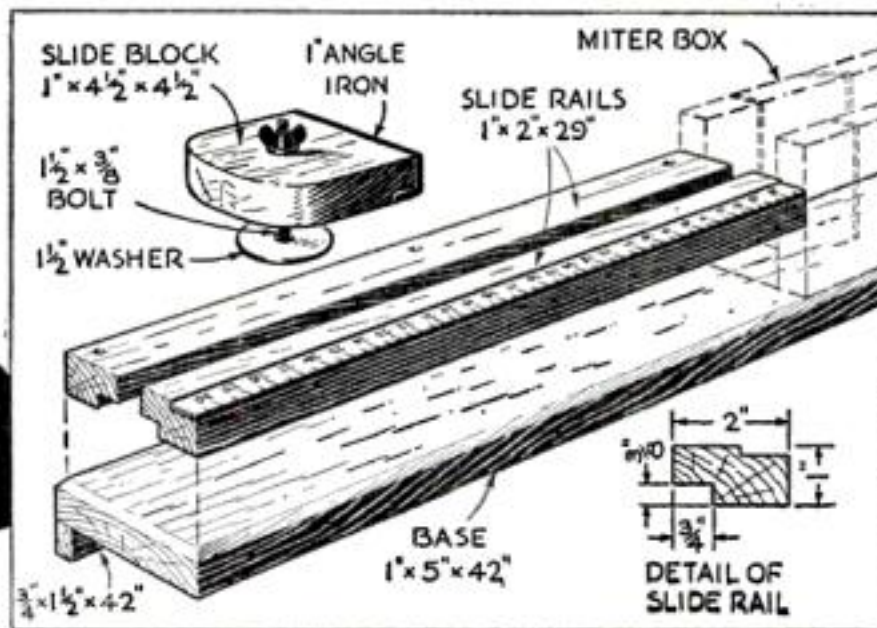


The block is simply a 1" by 2 $\frac{1}{2}$ " by 5" piece of hardwood with three or four holes bored in it of the diameters most constantly used. It is fastened to a $\frac{3}{4}$ " waste nut into which is inserted a 4" length of $\frac{3}{4}$ " pipe. The jig

will fit chisel-rest holders having a 1" hole, a common size. Before boring the desired holes, the proper size bit is inserted in its corresponding hole in the block, and the tip of the bit is aligned with the pin in either the spur center or the tailstock center.—F.H.

Adjustable Length Gauge for Use with Miter Box

At right are the parts before being assembled. Below, using the gauge



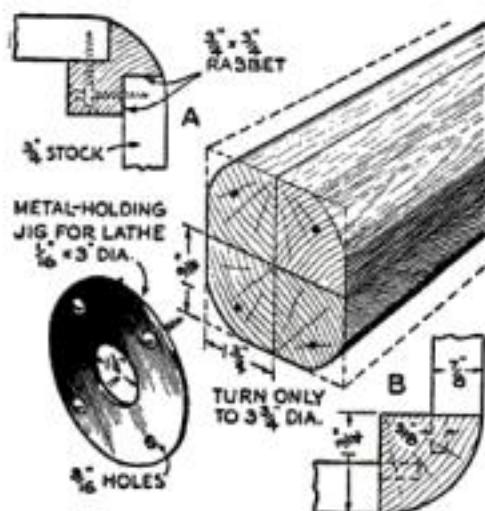
FOR cutting uniform lengths of wood by hand, this sliding gauge is used with an ordinary miter box, which is screwed to one end of the long base-board. The two slide rails, one of which has a yardstick attached to it, are then screwed in place and the adjustable slide block is made. Note that the slide block

can be clamped at an angle in case duplicate pieces of wood have to be cut on a miter.—CHARLES JEGLINSKI.

Furniture Corner Posts Turned Four at Once

NEAT, strong corner posts of rounded design for chests, desks, cabinets, and other pieces can be turned by holding four pieces of accurately squared $1\frac{3}{4}$ " by $1\frac{3}{4}$ " stock together with a metal plate at each end. The plates are made of $1/16$ " sheet iron as shown. These will keep the pieces together while being turned. This method is quicker than gluing the stock with paper between.

After the stock has been turned, take the disks off and put them away for future use. The pieces are then ready for the shaper or dado saw. Make the $\frac{3}{4}$ " by $\frac{3}{4}$ " cut on both sides of the rounds. If the corner opposite the round is in the way, plane it off, but in using soft woods it is advisable to leave the corner on.



The joints are fastened with glue and screws as at A. Another method of joining, which requires the pieces to be mortised instead of dadoed, is illustrated at B.—G. E. WILSON, SR.

Enlarging Dowel Holes with an Auger Bit

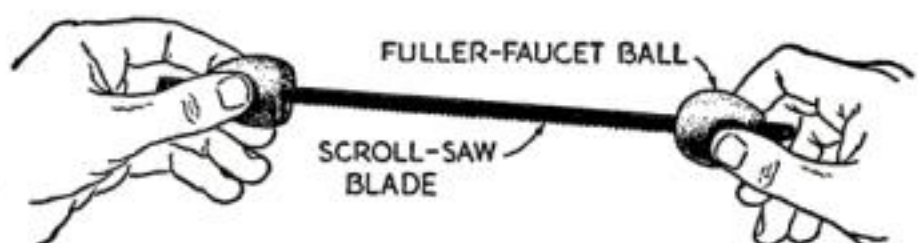
TO ENLARGE a hole with a wood bit and maintain the same center is usually very difficult. The lead screw of the larger bit can be centered, however, by obtaining a dowel pin that will fit loosely into the smaller hole. Cut off a piece $\frac{3}{8}$ " or $\frac{1}{2}$ " long and drill a hole through the center slightly smaller than the screw of the bit to be used. Screw the dowel on the bit as shown.

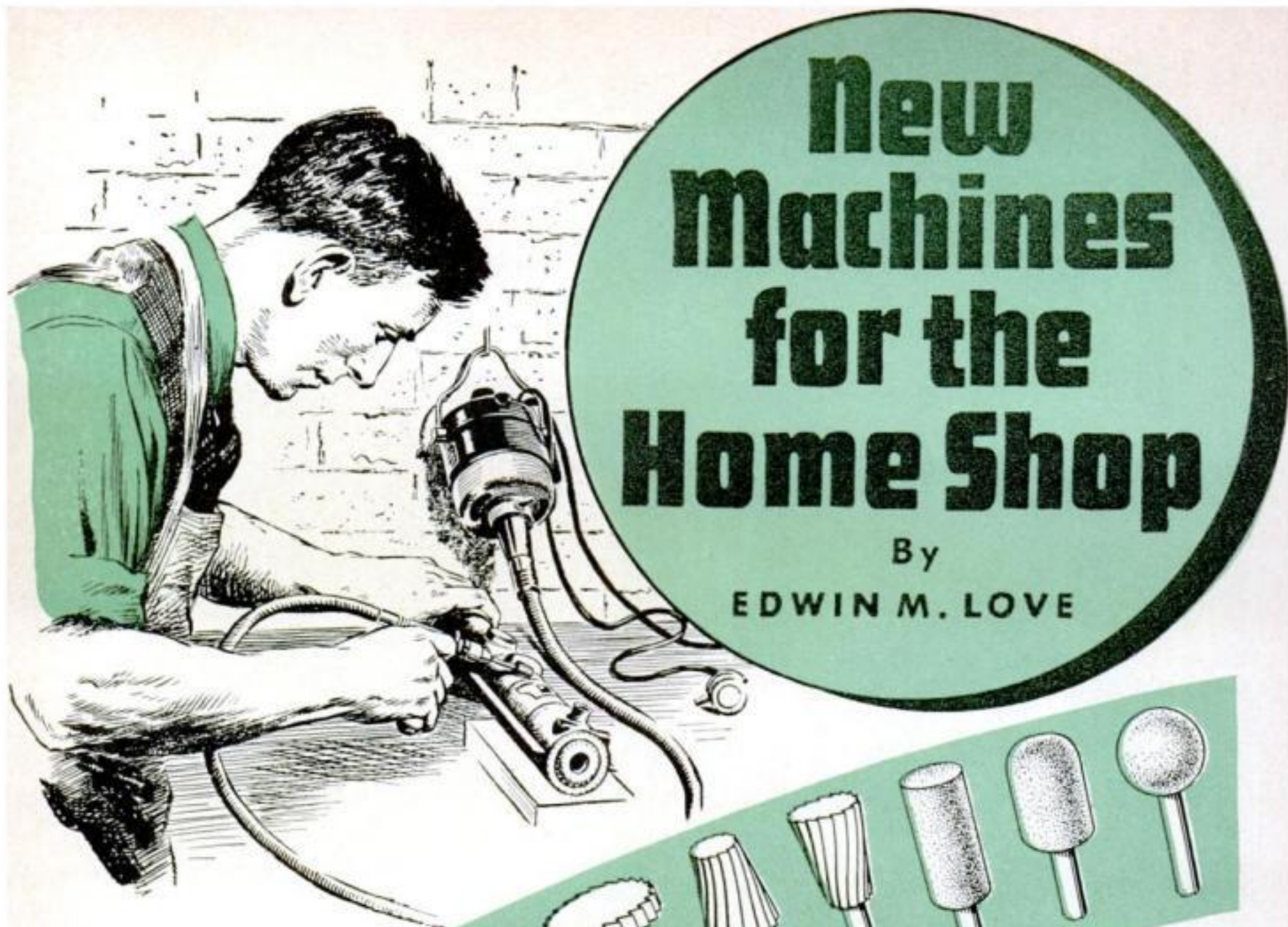


In reaming out holes in furniture, the hole can be started in this manner. Then the dowel may be removed to run the bit to the bottom. I have found this method very useful in reboring funnel-shaped holes in furniture where new dowels of a larger size are needed.—HORATIO WESTON.

Scroll-Saw Blades Held Without a Frame

WHEN a hand scroll-saw blade has to be used in close quarters where it is impossible to employ the frame to hold it, slit a couple of Fuller-faucet balls along one side and slip these onto the ends for finger grips.





New Machines for the Home Shop

By
EDWIN M. LOVE

Small flexible-shaft grinder being used to true up the boiler shell of a model locomotive

THE newer home workshop machines are, for the most part, units of proved value from the industrial field scaled down for home use. They are smaller in size, lighter in weight, and lower powered. In some cases they are interchangeable with the more familiar kinds, but often they are supplementary.

What new saws are there?

One is a circular saw which is the direct opposite of the usual one. The board to be cut lies stationary on the table, while the blade is drawn through it. The saw blade is mounted on a high-speed motor pivoted horizontally and vertically in a yoke hanging from an overhead arm. Depth of cut is regulated by a screw in the back post, which raises or lowers the track. Miter and other angular cuts are obtained

Above, some tools used with flexible shafts and hand grinders. Right, hand-motor carving



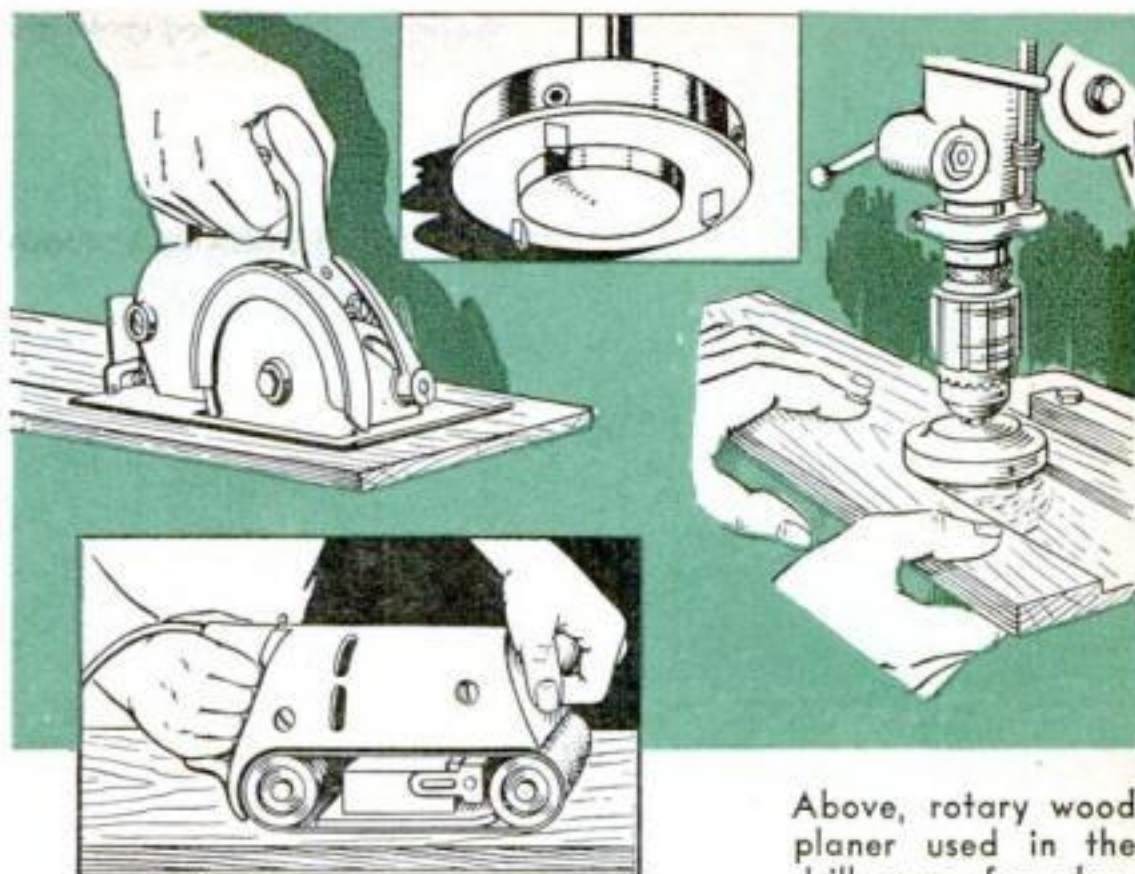
PART IX OF A NEW SERIES FOR BEGINNERS

by swinging the track to right or left, and bevels result from tilting the motor. The blade can be turned parallel to the fence for ripping or plowing. Boards up to 2" by 12" are readily cut.

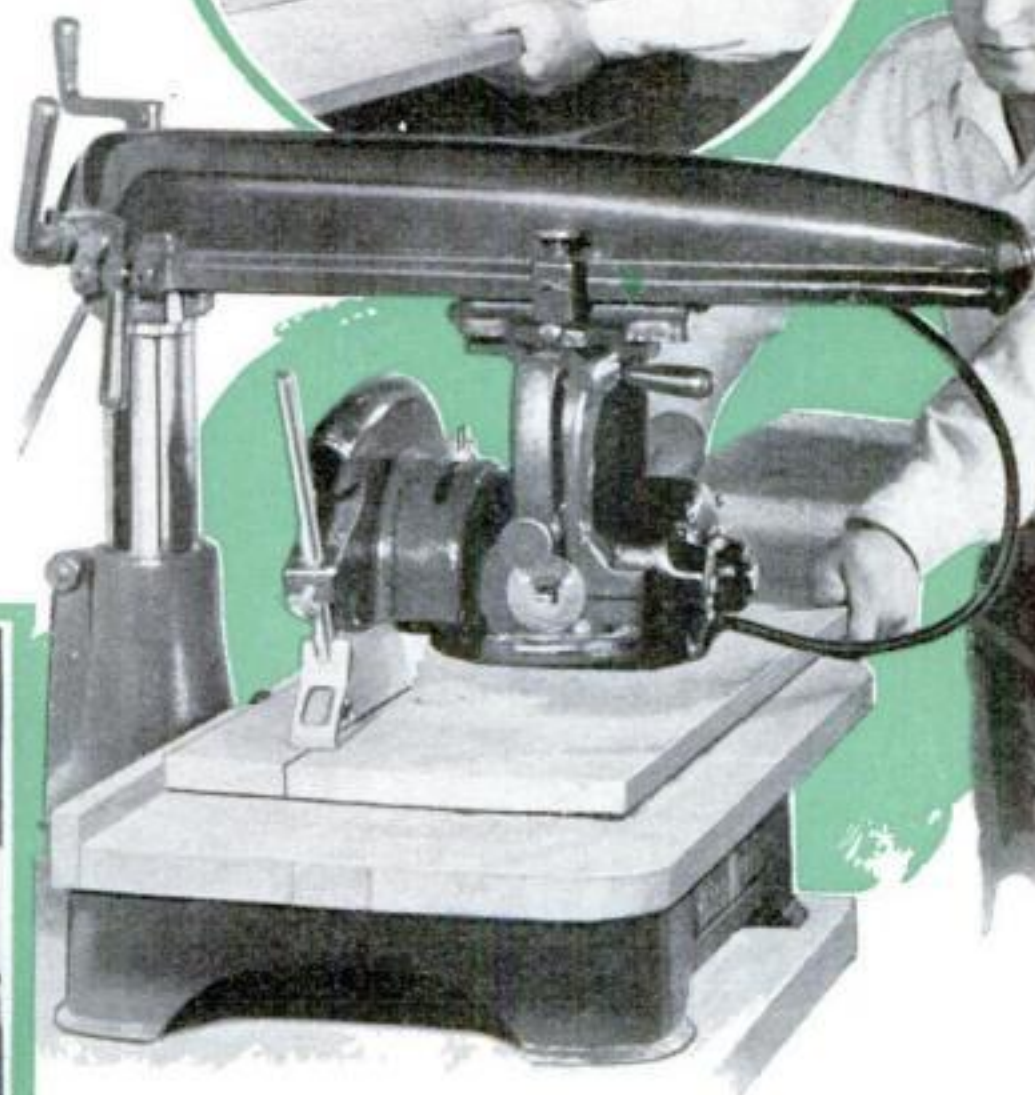
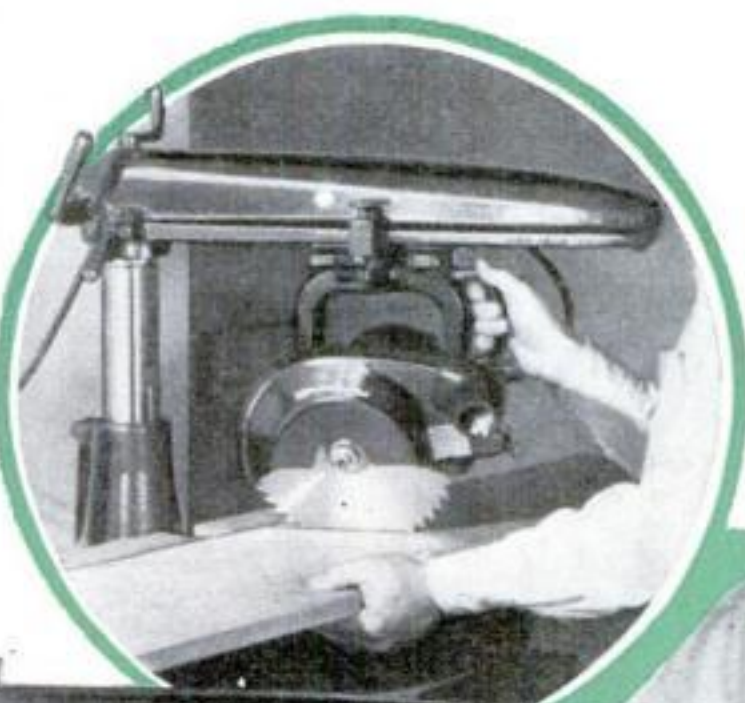
How is this type of machine advantageous?

Long boards can be laid in place and cut through, or dados made, by a simple gliding pass of the saw. Although there may be plenty of room in the home shop for projecting ends to clear machines, benches, and other obstructions, it is somewhat difficult to push a long board sidewise on a table saw for cutting across, even if the ends are carried by roller stands at the sides.

Because the overhead saw can be adjusted with the blade in a horizontal plane, it is easy and safe to cut tenons with the material flat on the table. If the saw blade is replaced with a shaper cutter, the machine becomes a spindle shaper. A sanding disk adapts it for smoothing small pieces that are difficult to shape accurately in any other way. The machine is so versatile that it substitutes very

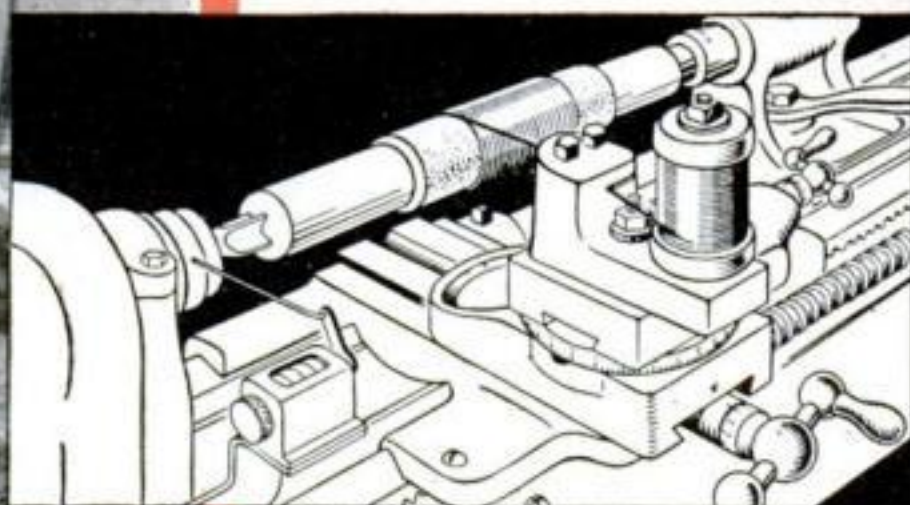
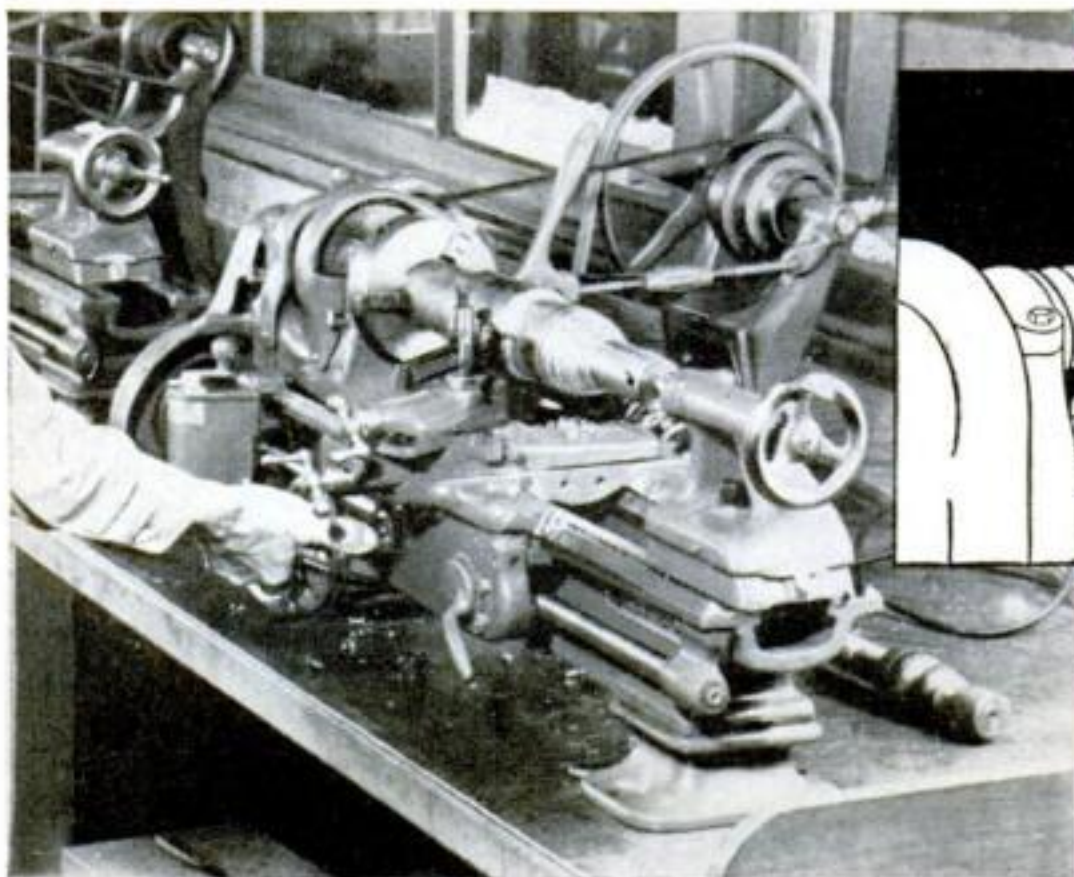


Above, rotary wood planer used in the drill press for planing, paneling, routing, rabbeting, and tenoning. At left above is a motorized handsaw. Below it is a small belt sander

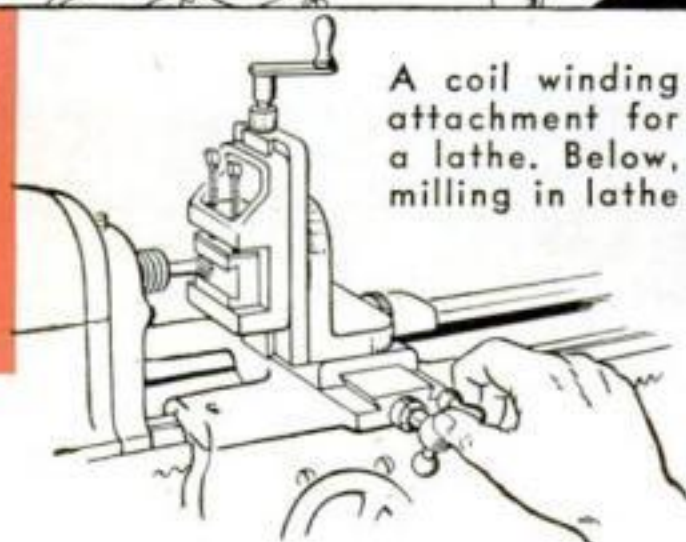


Ripping a long board with one of the new suspended-type or radial saws. In circle above, cutting a beveled miter with the same saw. Left, cutting two cheeks of a tenon at once





Metal-turning or screw-cutting lathes for the home workshop are of almost unbelievable accuracy and versatility



well in the home shop for several specialized machines.

Are motorized handsaws useful for home mechanics?

For a good many years carpenters have made use of small circular saws operated by electric motors and equipped with handles. A cross guide serves both as a rest and a gauge for the tool. It is a great time-saver in rough work, such as cutting studs, common rafters, and jack rafters. Sheathing boards are tacked in place with uncut ends overlapping on the rafter or floor joist; then both are cut to fit by the simple expedient of allowing the blade to shear through from above. Smaller versions of these saws are now marketed for use in the home shop. Lumber of any width and up to 1 1/4" thick can be cut with them. With suitable jigs, they will do comparatively fine work. Reciprocating saws, which amount to motorized keyhole saws, are also on sale.

What new planing and sanding machines are available?

A recent tool consists of a horizontal rotor armed with knives, to be used in a drill press. A rough board is rested on the press table, the rotating planer is brought down until a thin shaving is removed, and the quill is locked. By moving the board with the hands, the entire surface can be smoothed, and the board will be brought to uniform thickness.

There are several makes of small belt sanders which, like the motorized handsaw, are held and pushed by means of a handle.

These are excellent for light sanding, smoothing plastics and metals, and removing old paint. They are useful on vertical surfaces, such as walls, and also overhead.

How does a flexible shaft work?

It looks like an automobile speedometer cable. Inside the flexible casing is a shaft made of coiled spring-steel wire, powered at one end with a motor or stepped pulley, and delivering power at the other end through a small chuck. The slender chuck, carrying a drill, can be poked into awkward places for boring holes, or a grinding wheel may be mounted for use in dressing down castings or welded joints. A wide variety of attachments for use in the chuck are available. Wire brushes quickly remove rust; rotary brushes scrub floors or polish them; sanding drums smooth curves in wood or metal. Smaller shafts capable of speeds about 15,000 r.p.m. are handy for light carving.

Is it true that a small, high-speed motor or hand grinder can be regarded as a complete model-making shop?

Yes, this is practically so if the various available attachments are used. The best of these tools are precision machines, fitted with ball bearings and accurate chucks. They are self-contained, light in weight, and can be held like a pencil for light grinding or carving. Dental burrs in dozens of forms, and a multitude of grinding wheels, saws, and brushes are made for them. Accessories turn them into lathes, routers, circular saws, and drills. They can easily be converted

into a complete miniature shop.

What points should be considered in choosing a metal-turning lathe?

The size is important. Some are so small as to approach a jeweler's lathe in size, and do very well for small model work, but the buyer should be certain about what he wishes to make before limiting himself so much. A lathe with a swing (maximum diameter of work it is possible to turn) of from 6" to 10" is usually chosen for the home shop.

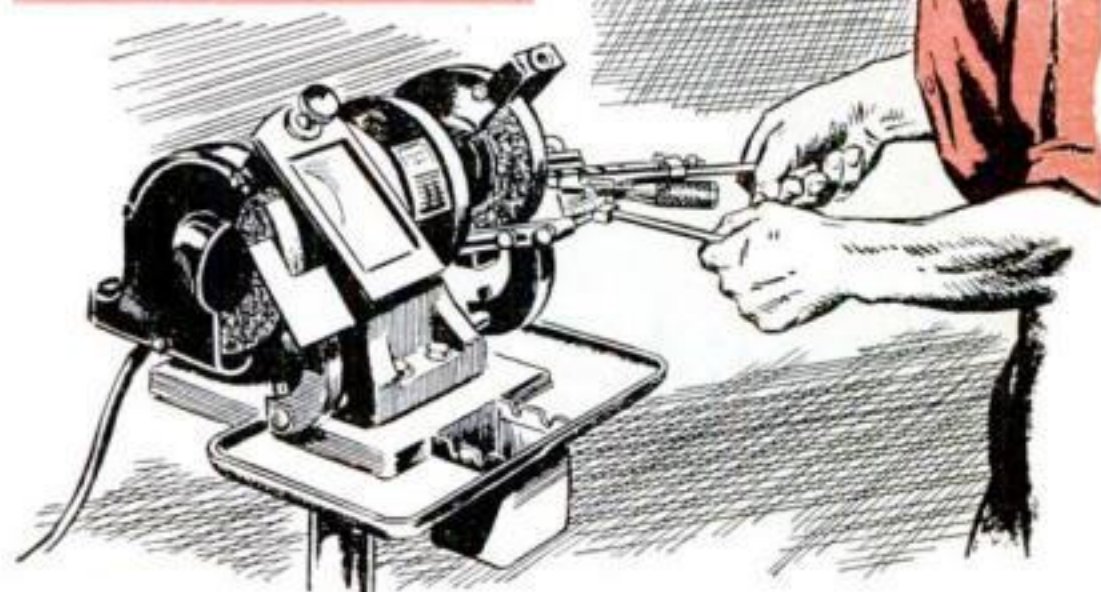
Obviously, the accuracy of work possible on a lathe depends on the accuracy of the lathe parts. Loose bearings result in work out of round or ridged with chatter marks; play in the carriage on the bed ways causes irregularity in the turning, and a bed not parallel to the center gives taper turnings. Reputable manufacturers make lathes of extraordinary accuracy and convenience, and give strong guarantees as to the parallelism and general dependability of their machines.

Among the accessories available are such handy devices as the taper attachments for making tapered parts, grinders to mount on the tool post, and turrets that hold as many as six tools set up for successive steps in turning, drilling, reaming, and the like. There are milling attachments for working flat surfaces, gear-cutting set-ups, and innumerable special accessories and tools.

(TO BE CONTINUED)



Another valuable accessory for the shop is a grinder attachment for sharpening twist drills with accuracy



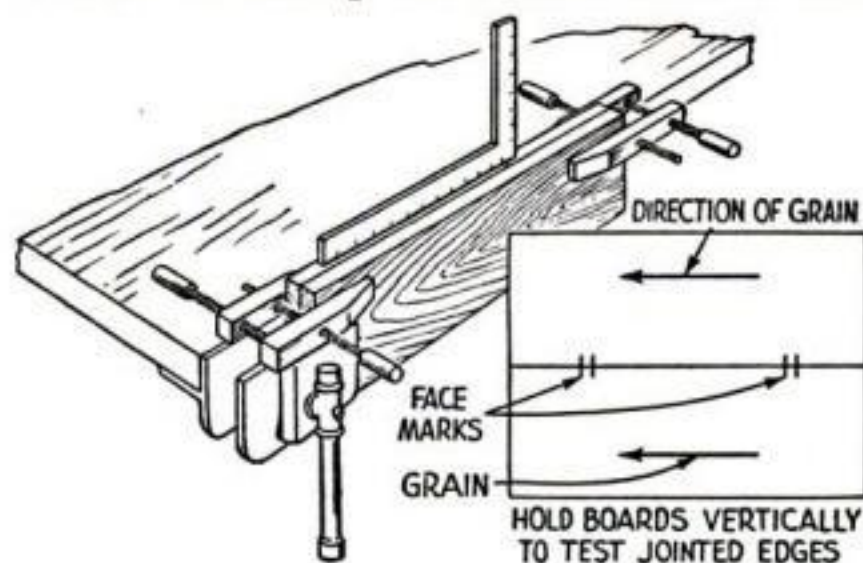
Applying Paint to Screens

THE problem of painting wire screening without clogging some of the holes in the mesh is readily solved by using a clean blackboard eraser instead of a paintbrush. Dip the felt surface evenly into the paint, remove any excess, and then apply to the wire with a rotating stroke.—R. M. W.

JOINTING BOARDS FOR GLUING

[WOODWORKING]

1. Place two boards in the position they are to occupy when glued. See that the grain of both boards runs in the same direction and mark the faces. 2. Clamp the boards face to face with two hand screws as shown.



Fasten them in the bench vise and plane both edges at the same time. Test for straightness with a steel square. 3. Place the edge of one board on top of the other (faces towards you) and look through the joint toward the light. A little light may show through the middle, but none at the ends.

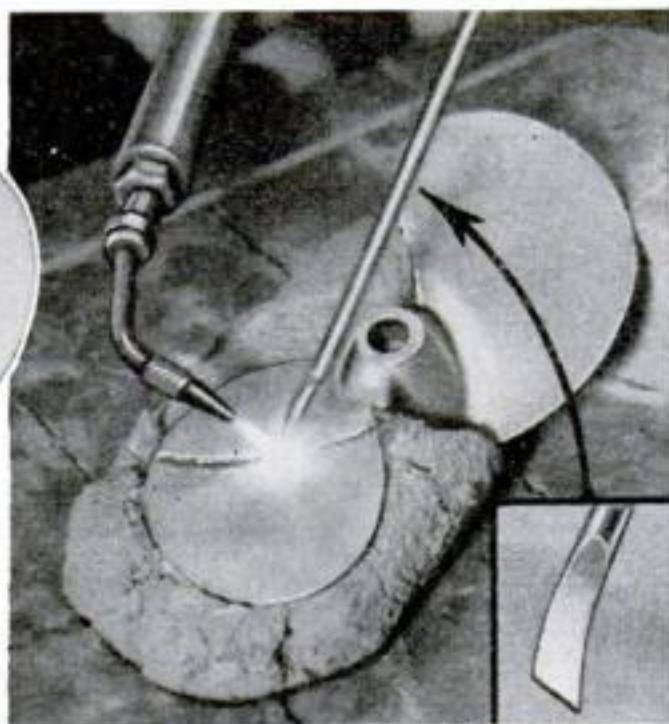
POPULAR SCIENCE MONTHLY SHOP DATA FILE



NEW SHOP IDEAS



At right, raking the joint. Above, the weld after being dressed down



Welding Aluminum WITH THE OXYACETYLENE TORCH

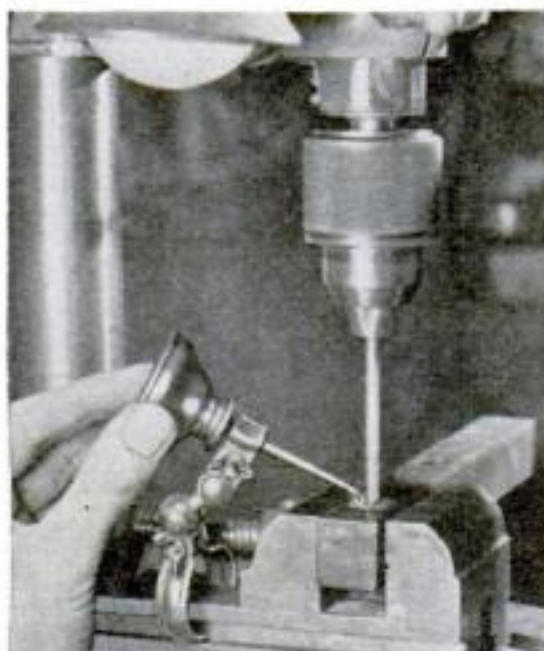
ALUMINUM castings and sheets can be easily welded with the oxyacetylene flame by using flux-coated arc-welding rods of five-percent silicon aluminum alloy. Where the shape of the pieces to be welded is such that correct alignment is difficult, as in the case of the broken outboard motor propeller shown, the parts are pressed into soft "mud" made from either fire clay or asbestos. The broken place should be clean and bright, and it must be backed with a strip of sheet iron to keep the mud out of the weld.

Use a slightly carburizing flame to heat the aluminum, and rake out a V along the break with a puddling rod. This may be made from a piece of steel welding rod about $\frac{1}{4}$ " in diameter, hammered flat and pointed on a grinder.

The actual welding is then done with a slightly carburizing flame. The tip of the inner luminous cone of the flame should just touch the metal. Apply enough heat to fuse the weld-

ing rod and parent metal completely. In this case $\frac{1}{8}$ " diameter rod was used. All flux should be removed after welding either with water or a dilute solution of nitric acid.—ROYALSTON F. JENNINGS.

Handy Drill-Press Lubricator



A CONVENIENT way of applying lubricant when using a drill press is to mount an oil can so that every time the bottom is pressed, a shot of oil is directed at the hole. The can must be one that does not leak when turned spout down. It may be clamped to the vise by means of a ball-and-socket joint as shown, or mounted somewhere on the drill press.

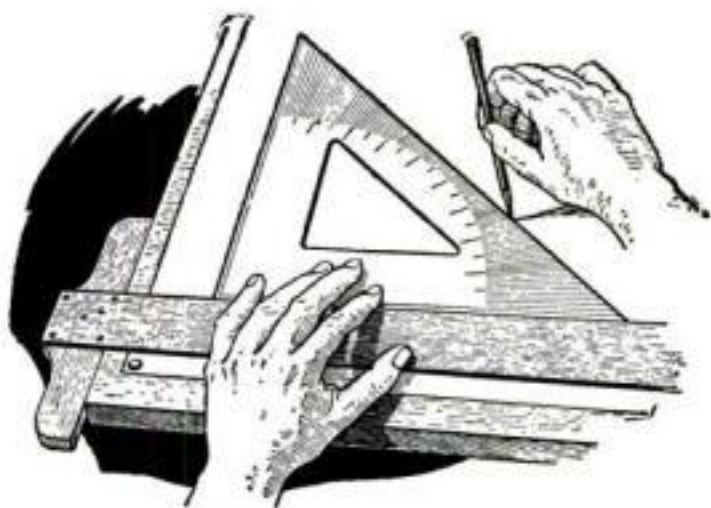
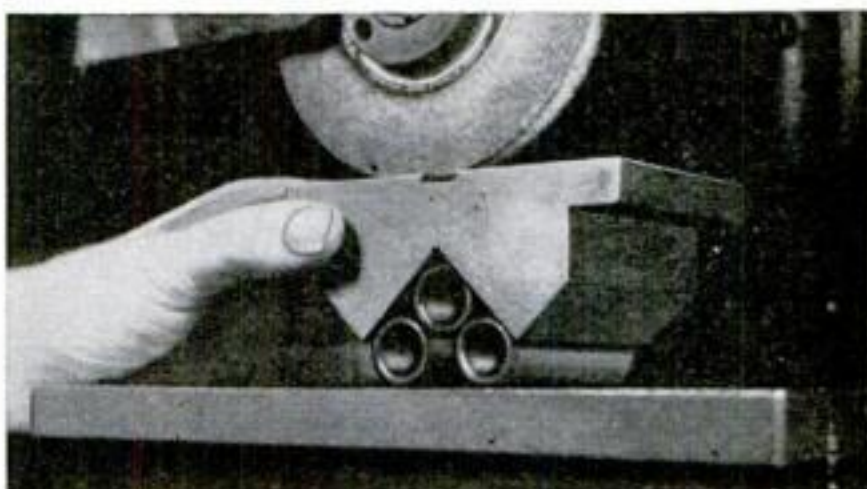


Three Rods Hold V-Block True for Grinding

WHEN it is necessary to set up work by means of a V-groove, three round bars or tubes may be used as shown below. In this particular instance the base of a V-block had to be ground true with the V. It was accomplished by making use of three automobile piston rods, all of equal diameters. Two solid steel parallels were then placed on either side of the V-block to hold the work on the magnetic chuck—J. E. S.

General Utility Reamers Made from Old Taps

USEFUL reamers for ordinary rough work can be made from tapered threading taps which have been discarded because of broken ends and cutting edges. These are ground as illustrated above, the bottom of the threads being used as a guide. They should be ground slightly more on the heel or back of the cutting edge so as to follow through without binding. The regular tap and die handle may be used.—M. W. MUTSCHLER.



Triangle Used as Protractor

IN THE usual run of drafting, a protractor is seldom used and, therefore, is put away where it takes time to find when needed. Also, many protractors are too small for very accurate work. Both these difficulties may be overcome by scribing a series of lines as indicated on a 45-deg. celluloid triangle, 12" or larger. I used a divider to space the lines and scratch them in, then went over the scratches carefully with a pocketknife held sideways to the lines.—I. J.

CARE OF OILSTONES

[SHOP PRACTICE]

Soak a new stone in oil for several days before using, unless it is of the oil-filled variety. Keep it in a box with a closed cover and leave a few drops of fresh, clean oil on it.

To preserve the flat, even surface, sharpen tools on the entire stone surface. Turn the stone end for end occasionally. A mixture of machine oil and kerosene (half and half) works well on most stones, although there is a special oil for this purpose. Some stones give best results with water, such as those made from natural rock.

Keep a supply of waste handy and wipe off dirty oil as soon as possible after using the stone. If the stone gets gummed up or becomes glazed, its cutting qualities can usually be restored with gasoline or ammonia. Scouring the stone with loose abrasive or with sandpaper fastened to a perfectly smooth board will sometimes help. If a silicon-carbide stone becomes clogged, it can be renovated by heating in an oven or over a fire. Place it in a pan to catch the oil and dirt that will ooze out. Wipe the stone dry while it is hot, then resoak in oil.

If a stone becomes uneven, its flat surface can be restored by grinding on the side of a grindstone, or rubbing down with sandstone or a rubbing brick.

Porous stones may be tempered in their cutting by filling the surface with wax or vaseline.

POPULAR SCIENCE MONTHLY SHOP DATA FILE



Small Alcohol Torch Softens Hard Putty

HARD putty around a broken window pane can be softened by running the flame of a small alcohol torch around the edges of the glass. It is then readily removed. When the new glass has been puttied, the putty may be heated in the same way in cold weather to make it easy to smooth.

Countersink Is Cut Off and Used in Chuck



IF HELD in the chuck of a breast drill or an electric drill, a tool made by cutting a rose countersink bit as shown will enable countersinking to be done many times faster than by slow rotation in an ordinary brace. A good quality rose bit will be found efficient for metal as well as wood.

In cutting cast iron no lubricant is required, but with other metals use the prescribed lubricant.—W. C. W.

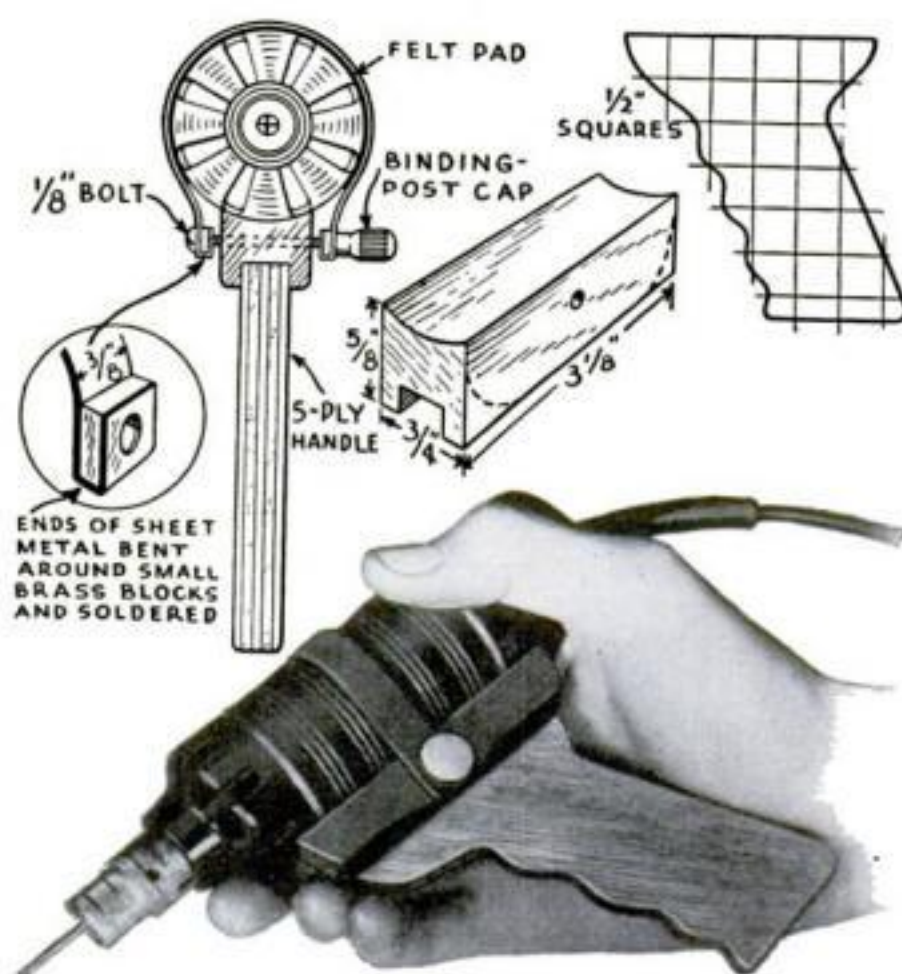
Grip-Type Screw Driver Picks Up Small Parts

WHEN work is being done on hot and dirty motors or similar jobs, a grip-type screw driver will often be found an aid in recovering a washer, nut, or other small part that has accidentally dropped into some hard-to-reach crevice. By catching hold of it with the gripping mechanism, you can lift the part without danger of soiling or burning your fingers.—J. M.



Pistol-Grip Attachment for Hand Grinders

A PISTOL-GRIP attachment for small hand grinders is easily constructed and adds considerably to the versatility of the tool. It is made from $\frac{3}{8}$ " five-ply wood and a small block scooped out to fit the contour of the grinder. The block is rabbeted as shown to receive the handle. The handle is set in place on the grinder, and the sheet-metal band is adjusted so that when the thumb nut is tightened, the band will grip the grinder firmly. The band is lined inside with felt so that it will not scratch the barrel of the grinder.—RICHARD HANSCOM.



Inner-Tube Repair Bench

A MECHANIC on a road-construction crew, who frequently had to make minor repairs on inner tubes from large truck tires, was at loss for a convenient bench for cleaning the tubes and applying patches. At length he found that a shovel, clamped in his bench vise as shown, would serve the purpose.—C. E. H.

Shellac Cements Screws So They Won't Loosen



BOLTS, nuts, and set screws will be less likely to loosen if you coat the threads with shellac before tightening them. If it is ever desired to unscrew the parts, simply apply heat to the bolt.

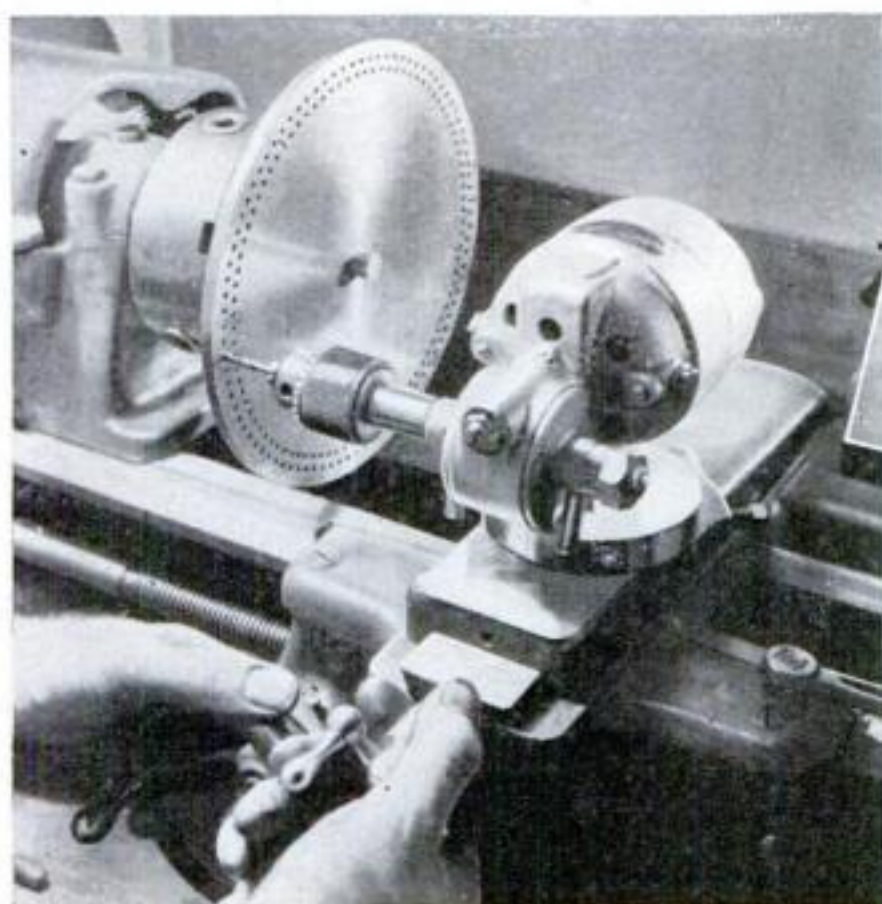


On construction or road jobs, a shovel will act as a bench for making temporary tube repairs

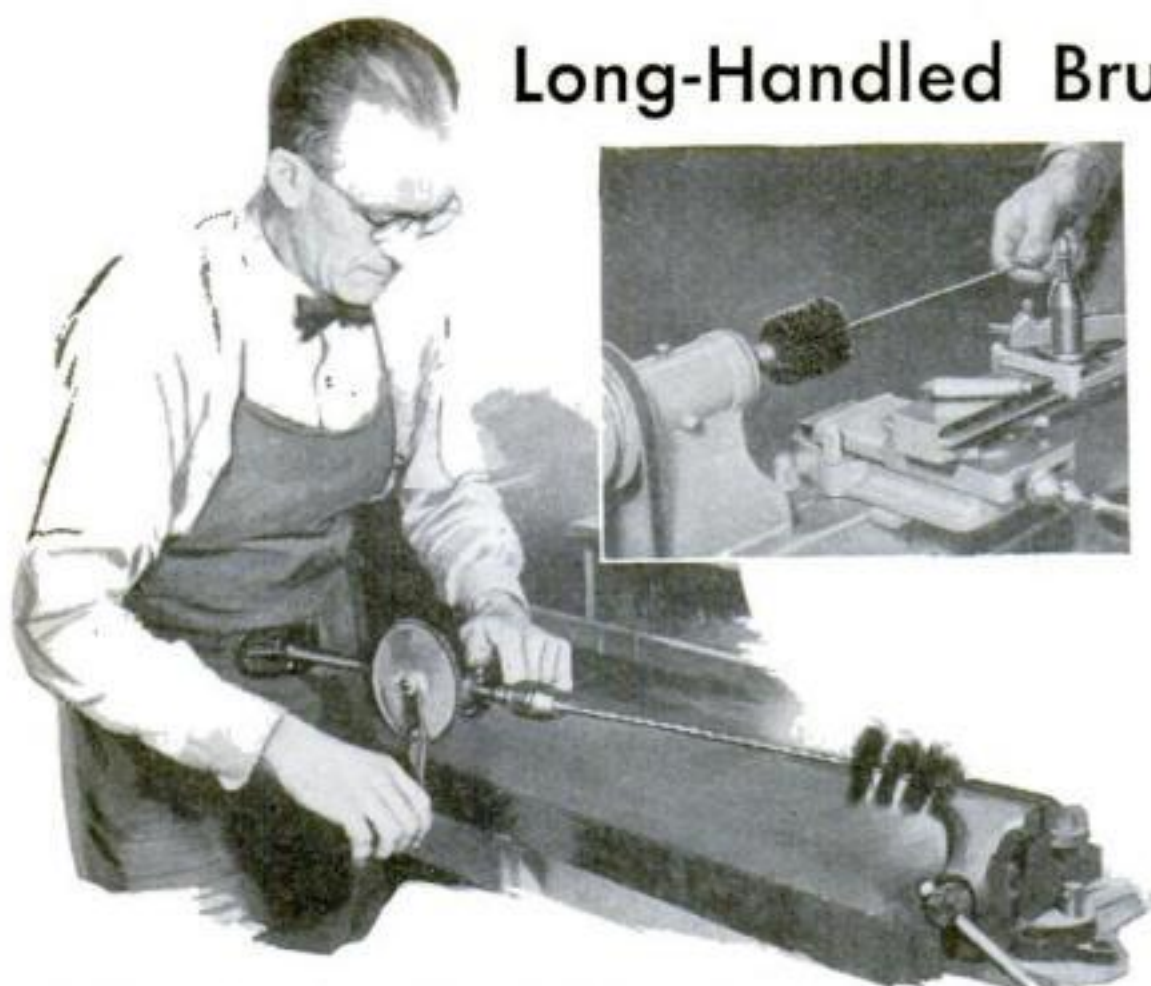
Motor Drill for Lathe Cross Slide

THE handy motor drill for the cross slide of a lathe illustrated below was made from a small worm-gear motor. The shaft was drilled to receive the shank of the drill chuck as shown, and the shank was fastened with a set screw. To attach the motor to the cross slide, a disk was turned as illustrated in the lower photograph at the right. The disk has a clamping lug that duplicates the one on the compound rest, which is removed so that the motor can be mounted in its place. The disk must be of sufficient thick-

ness to bring the drill to exact lathe center height. The micrometer dial on the cross slide can be used for the accurate spacing of the holes radially across the work, as shown in the photograph of the whole set-up.—C. WARREN WOODSON.



The drill is fastened to the cross slide in place of the compound rest



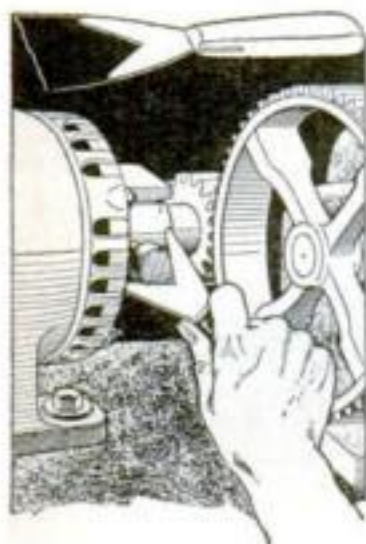
Long-Handled Brush Cleans Spindle

HOLLOW spindles of wood or metal lathes should be kept clean. If chips accumulate in the spindle, especially in metal turning, they are apt to be injurious to the spindle walls and tapered centers.

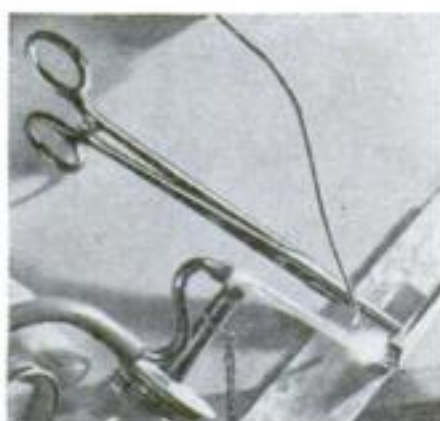
A brush for cleaning the spindle can be made from wire 40" long, bent double, and the bristles of a discarded 2" or 3" paintbrush. After being cleaned, the bristles are spread out between the wire at the bent end and gripped in a vise. The cut ends of wire are then tightly chucked in a breast drill and twisted for a length of at least 16". Keep the wire taut while twisting.

Twisting the wire. Above, brushing chips from the spindle

Knife Loosens Grease Cups



A SIMPLE tool to facilitate the removal of grease-cup caps may be made from a broken or discarded putty knife by cutting a V-notch in the blade. It is used as shown. Small grooves filed on the inside of the notch will provide a better grip, if it is needed.—H. G.



Old Forceps Are Valuable for Shop Work

OLD artery forceps, which are often discarded by doctors when the plating wears off, make a useful tool. A ratchet catch enables them to be used as clamps for soldering or assembling small work.

SWEDISH OR STATUARY PUTTY

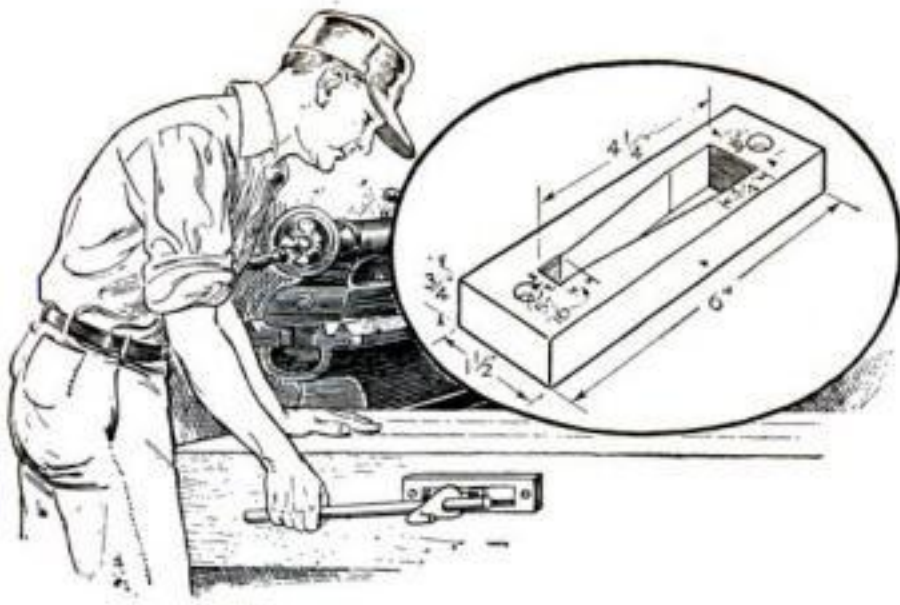
[FORMULAS]

For patching walls before painting or papering them and for repairs to modeled, carved, or embossed work, an excellent putty can be prepared as follows:

Fuller's earth.....	1½ lb.
Lime, slaked.....	3 lb.
Whiting	4 lb.
Linseed oil.....	1 pt.
Four-hour varnish.....	½ pt.

Mix to a stiff dough that can be kneaded in the hands. Consistency is controlled by adding whiting or reducing the quantity of liquid, as required. Keep under water until used up. Color the mixture with pigments ground in oil when necessary. This is a very versatile material and has many uses.

POPULAR SCIENCE MONTHLY SHOP DATA FILE



Wrench for Lathe Dogs Fastened to Workbench

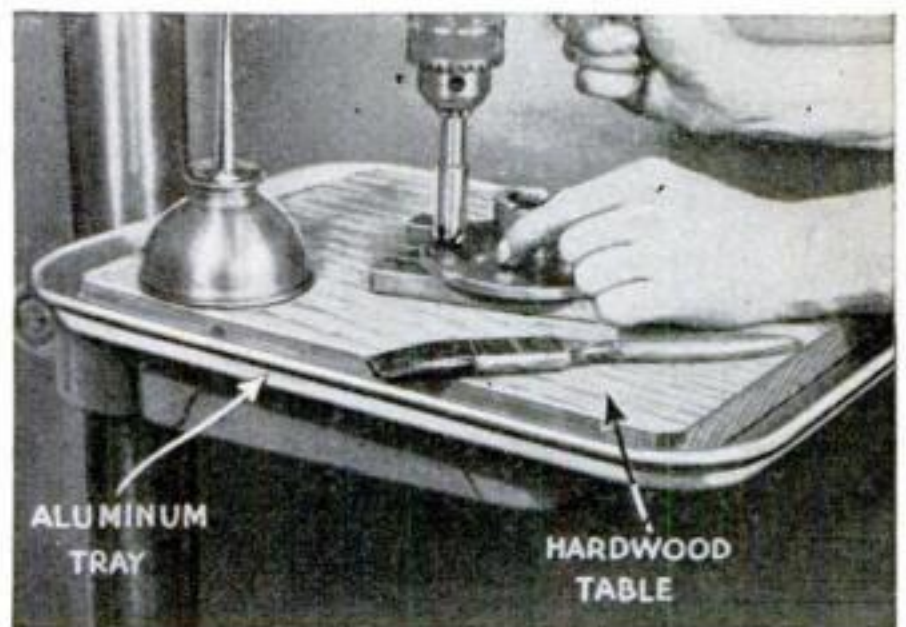
A LATHE-DOG wrench made as illustrated above and fastened to the side of the workbench is much faster to use than a vise. The tapered slot will accommodate any bolt-head from $\frac{5}{16}$ " to $\frac{3}{4}$ " square and, of course, nothing larger than $\frac{3}{4}$ " would be likely to be handled in this manner. The wrench should be made of steel and pack hardened.—FLOYD S. SHOOK.

Working Nickel Alloys

THE standard lubricant to thread, bore, ream, and broach nickel and its alloys is sulphurized oil. So-called "water-soluble oil" gives best results for cold sawing and grinding. These materials can be turned, planed, and milled dry or with sulphurized oil.

Drill-Press Oil Table Made from a Tray

FOR some time I had desired an oil table for my drill press, but hesitated to invest nine dollars for one since it was only for on-and-off use. Finally I made a table from a 14-gauge aluminum serving tray 11" by 15" obtained from a secondhand dealer in restaurant supplies. I cut down the top of a discarded parlor table to 10" by 14", rounded the corners, and fastened it to the tray as shown below with a quick-setting liquid cement. All that remained was to drill and countersink two $\frac{3}{16}$ " holes to bolt the assembly to the regular drill-press table when desired. My oil table cost only twenty-five cents, yet it has gained many favorable comments from my friends.—A. TASHJIAN.

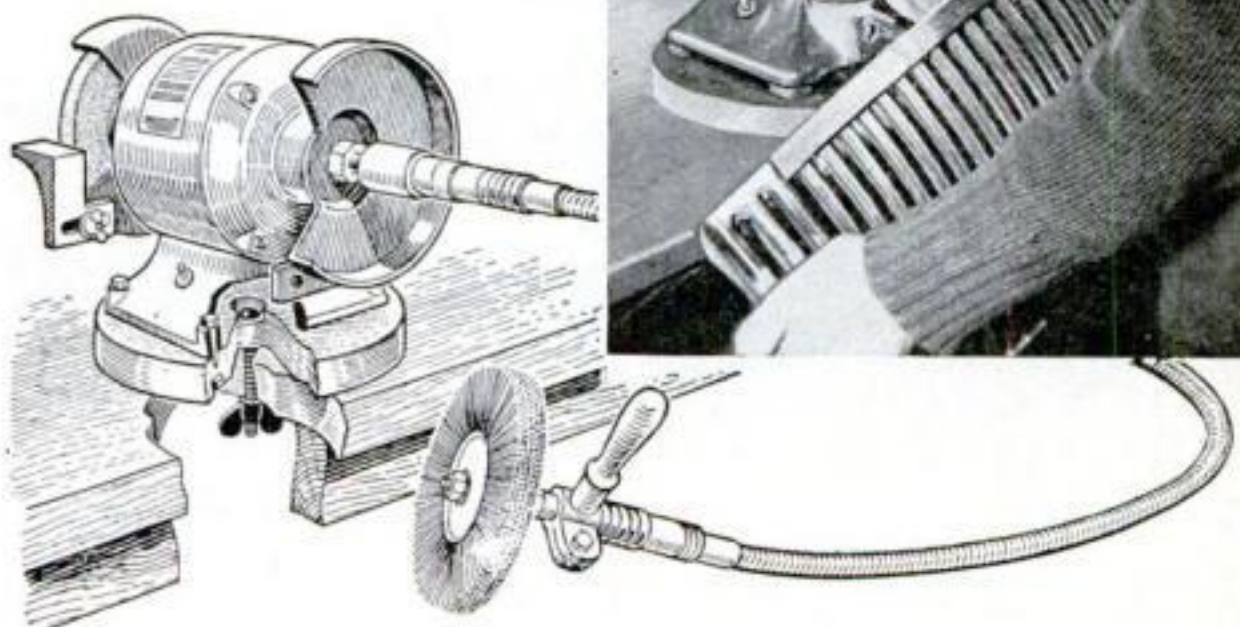


Made from an old serving tray and a table top, the assembly is held on the drill-press table by bolts

Grinder on Swivel Accommodates Special Work

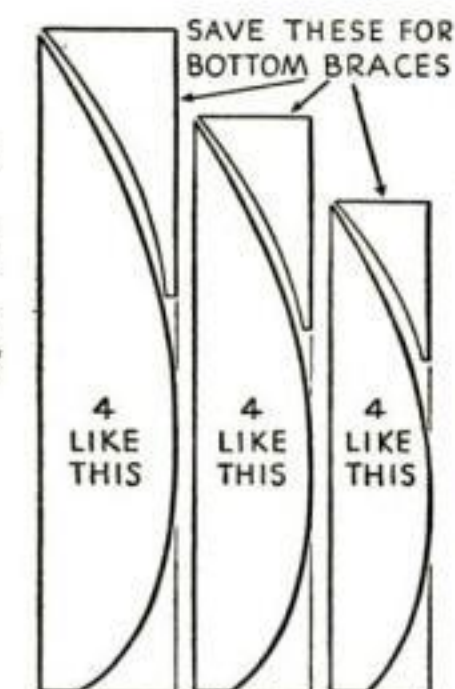
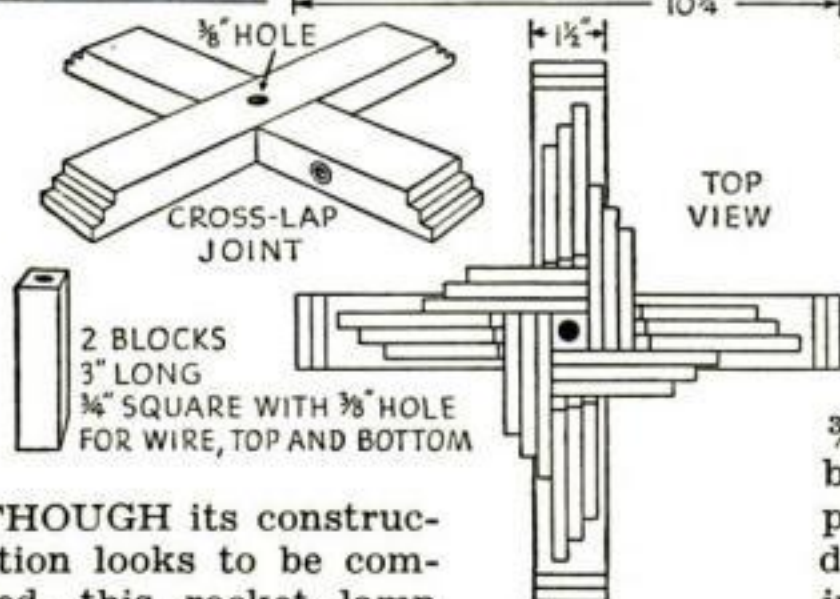
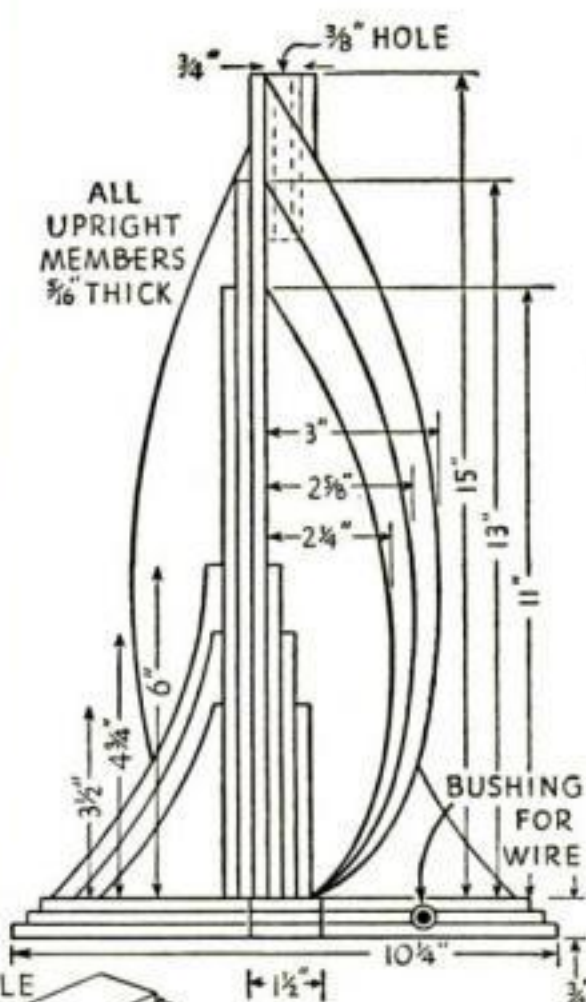
THE addition of a swiveling base between an ordinary motor-driven tool grinder and the bench will facilitate many operations. For example, the grinder can be turned for grinding large work as shown, in this case a boss on the inside of a radiator grill. The motor can also be used to supply power to a flexible shaft for work on a large object in front of the bench.

The base is a 10" diameter piece of hardwood. Drill a $\frac{1}{2}$ " center hole and counterbore with a $\frac{7}{8}$ " drill to a depth of $\frac{3}{8}$ ". Place a $\frac{1}{2}$ " carriage bolt through the hole, long enough to take a wing nut under the bench. Install so a wheel overhangs the bench slightly when parallel to the edge.

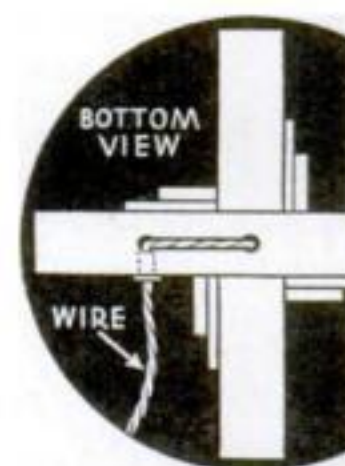


Ultramodern Table Lamp

OF ROCKET DESIGN

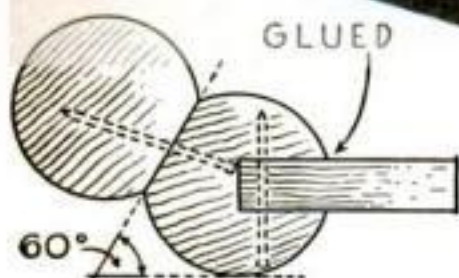
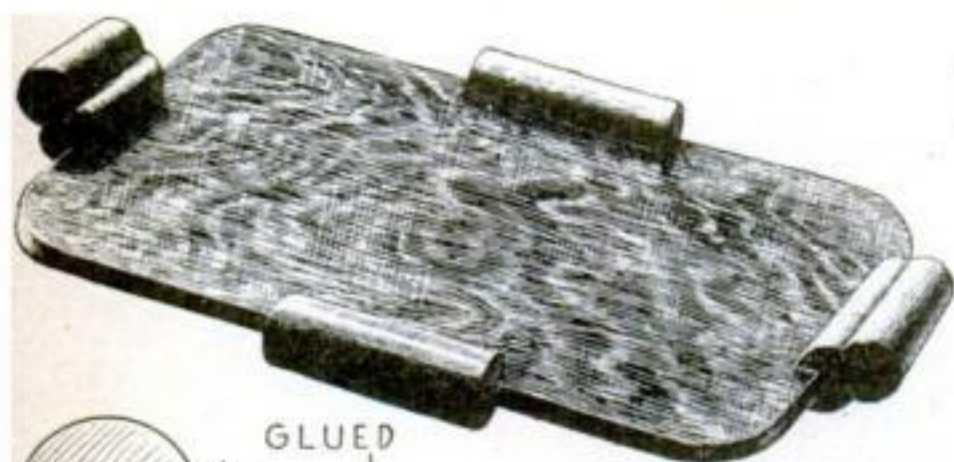


Left, how uprights are cut out. Above, the completed lamp



ALTHOUGH its construction looks to be complicated, this rocket lamp is really quite simple. The standard consists of four sets of scroll-sawed or band-sawed pieces of $\frac{5}{16}$ " wood assembled on a cross-lap base around two filler blocks,

$\frac{3}{4}$ " square, at the top and bottom. The filler blocks and base are bored to permit the passage of the lamp cord, as shown. The dimensions given are for a rather large reading lamp, but shorter models can be easily made by shortening the upright elements. The assembled lamp is finished in a high-grade enamel, and a modern shade made or purchased to match.—W. W. WHITE.



The tray is shaped from plywood $\frac{3}{8}$ " by 12" by 15". Sidepieces are 4" long, handles 3" long, assembled as at the left

Handles for Plywood Tray Cut from Curtain Pole

THIS plywood tray has handles and feet cut from a wooden curtain pole. Scrape the old finish from the pole, cut six pieces to the correct sizes, and cut slots to the center of four of them to fit the plywood. Form the handles as shown, fastening the parts together with glue and brads driven through from inside the grooves. Then glue and brad the handles in place. Finish in contrasting colors.

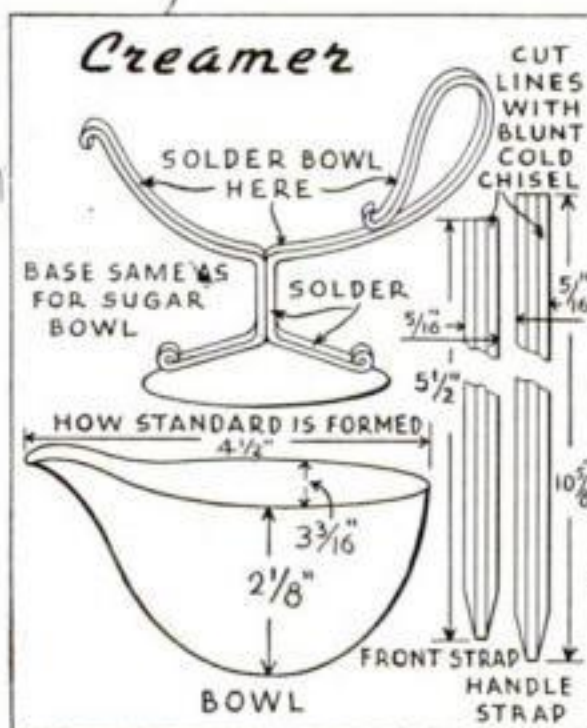


Creamer and sugar bowl. Lower right, rolling rim

DECORATIVE Tea Set OF HAMMERED NICKEL SILVER

THE tea set illustrated is made entirely from 18-gauge soft nickel silver. The sugar-bowl blank is a $4\frac{1}{2}$ " disk; the creamer-bowl blank is a pear-shaped piece $3\frac{3}{4}$ " by $4\frac{3}{4}$ ". Use a ball-peen hammer to cup them into bowl shapes as deep as possible by going over them once. Anneal and repeat until the proper depth is obtained. Form a rim around the edge of the sugar bowl, and also form the spout on the creamer.

All parts are soldered as shown. Apply solder to each point of contact, then clamp the pieces in position and sweat together with a blowtorch. When completed, clean the pieces thoroughly



with muriatic acid and polish. Do not allow the acid to come in contact with hands or clothing.—D. H.

Photo Cut-Out and Frame Sawed from One Piece

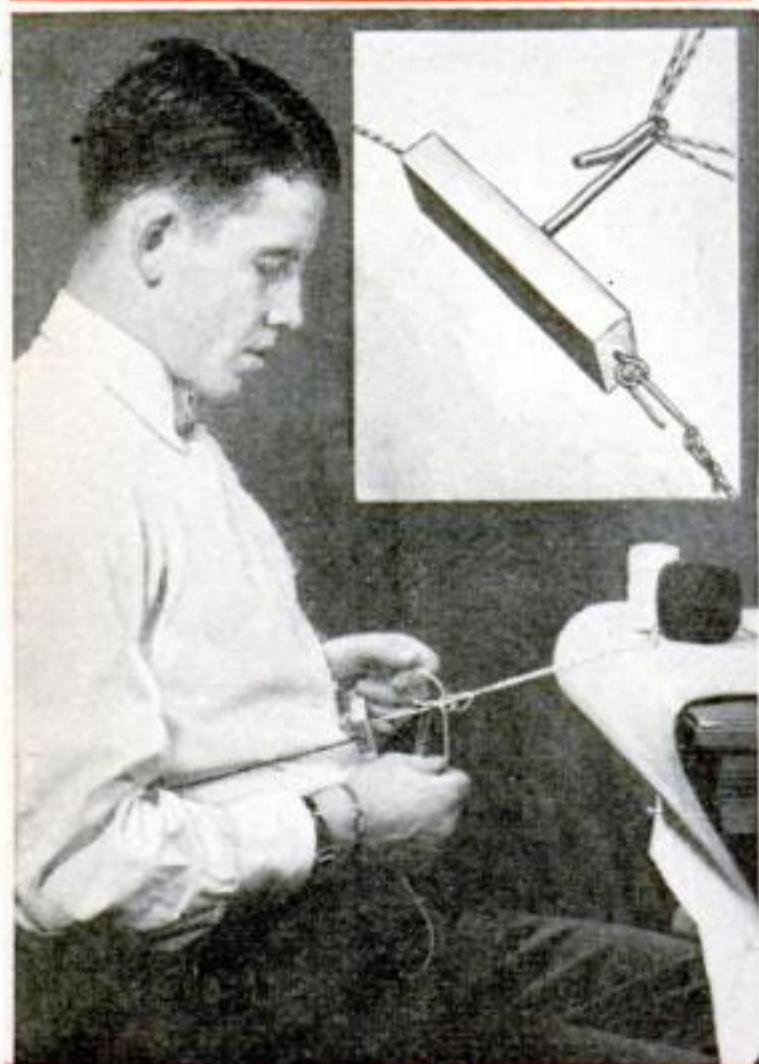
MANY types of photos lend themselves to making novel cut-outs like that shown. Mount the print on $\frac{1}{4}$ " plywood with dry-mounting tissue or paper (rubber) cement. With a compass and drawing ink, lay out the circular "frame." Then cut out the waste material with a scroll saw and smooth the rough edges with a piece of



fine sandpaper and a small file.

The edges can be left the color of the natural wood or treated with ink or colored lacquer. To tone down the objectionable white edges of the print, rub them with a soft lead pencil. It is a good idea to give the cut-out, picture surface and all, a coat of clear lacquer or varnish for protection.—W. B.

AN EASILY LEARNED,
FASCINATING HOBBY



Square Knotting

By

KENNETH MURRAY

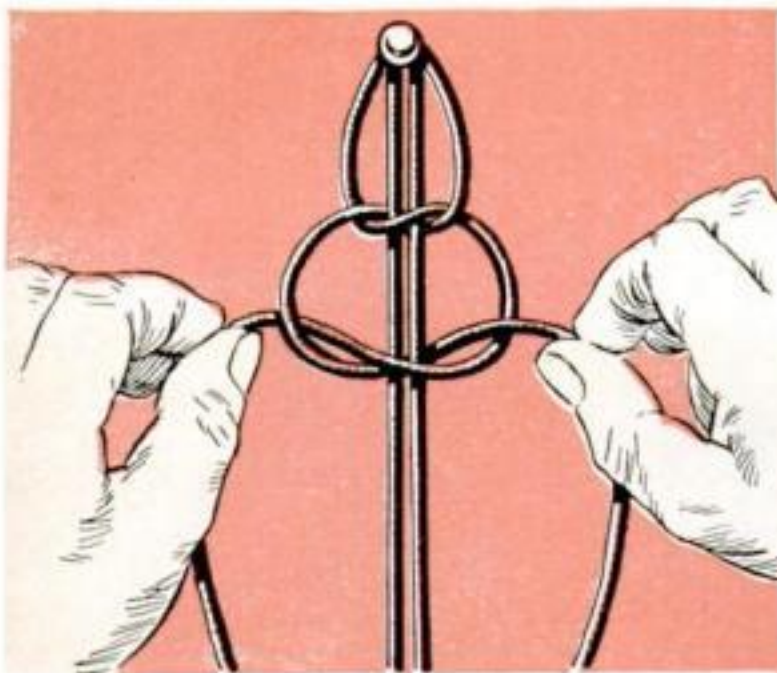
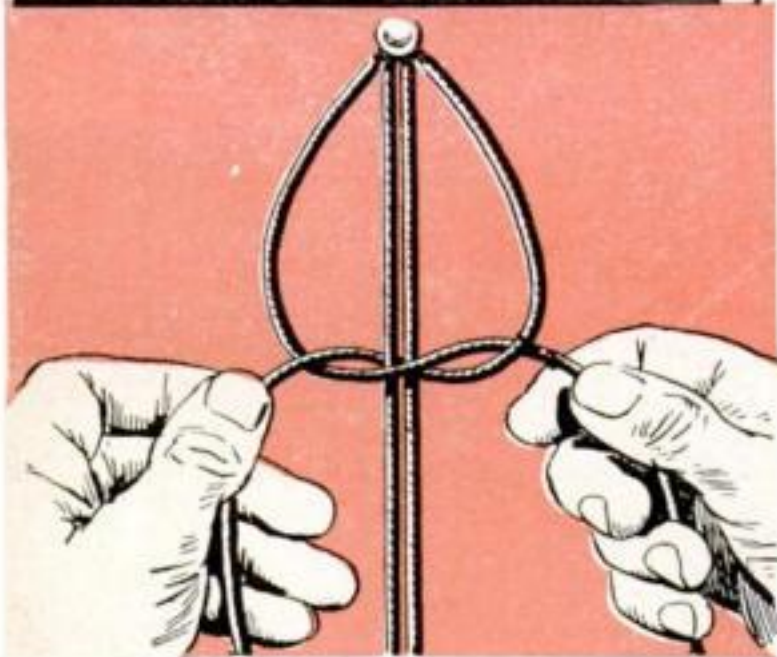
SQUARE-KNOT work is a most enjoyable hobby. To find out how fascinating it is, all you have to do is to learn how to knot plain cords from four or more strands. In addition to the projects illustrated, the knotted strands may be used for neck cords for suspending pens and pencils, guitars, and other musical instruments, and as pulls for Venetian blinds; for decorating the edges of pillows, lamp shades, and furniture covers, and even for decorative shoe laces.

The best work is done with cords made especially for square knotting. These may be obtained in a large number of colors, sizes, and materials. Any department store, however, offers a range of cords which may be substituted. Colored silk cord lends itself particularly well to decorative treatments, while a hard linen cord is more practical where the knotted cord is intended for hard service.

For a beginner, the following method of tying is recommended: Two doubled cords are used, making four strands. One is known as the filler cord, and when doubled it should be slightly longer than you wish the finished knot-work cord to be. The knotting cord should be about nine times as long as the finished work. Each is doubled, and the loop is held to the edge of a table or the back of a chair with a push pin or tack.

The filler cords are caught in a knot-work hook so that they will be held taut. A suitable hook may be made as shown and fastened with a cord passing around your waist.

To commence knotting, hold one of the free



Above, how square knots are tied and, at top, the knotting hook. Right, a variety of cords



THE MATERIALS ARE CHEAP,
NO TOOLS ARE NEEDED,
AND YOU CAN CARRY
YOUR WORK ABOUT



Strap for wrist
watch, cord for a
monotone filter,
and, below, safety
cord for a camera

cords in each hand and make the first half of a square knot around the filler cords as illustrated. Make the second half of the square knot in the same manner, then draw them up tightly.

Continue making square knots over the filler cords, drawing each knot up tightly against the preceding one, until the work is as long as you wish. This lays the groundwork for attempting complicated projects.

For a specially decorative effect, tie only the first or second half of the square knot. If done continuously, this will give the cord a twisted or spiral effect.

Another type of knot, originated by the author, gives a figure-8 effect. It is made by using the filler cords for the knotting cords; that is, after each knot is made, replace the filler cords in the hook with the knotting cords. Another means of injecting variety is to use cords of contrasting color.

When making knots with silk thread or cord, you will sometimes find that the nature of the material makes it difficult to draw the knots up so tightly that they will not become loose. Prepare a solution of about 25 grains of ordinary rosin in 2 oz. of rectified spirits of turpentine, then mois-

A spiral effect made
by using half knots, and a
figure-8 or interchanged knot

ten a flannel cloth with the liquid and draw the cord through it before commencing work.

If you should wish a finished piece of work to be quite stiff for some particular purpose, dip it into a pan of molten paraffin or a solution of varnish, well diluted with turpentine. Allow it to dry for at least a week.

When you cut the ends of cords off close to the final knots of a piece of work, the knots will not loosen if treated with a drop of clear finger-nail polish or cellulose cement.

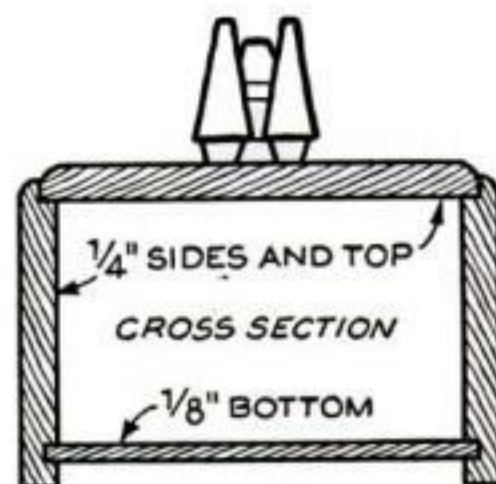
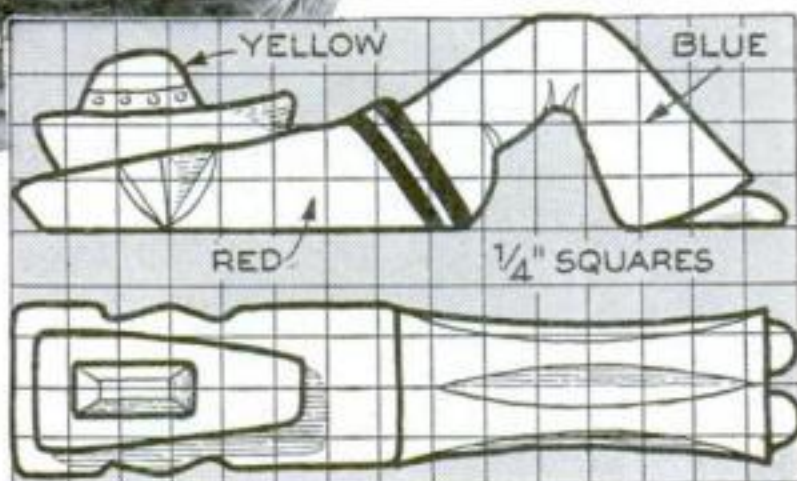
SLEEPING PEON DECORATES

Mexican Cigarette Box



MEXICAN cigarette boxes are often exceedingly colorful, charming bits of craftsmanship. The one illustrated is fairly easy to duplicate. In the original, balsa wood, assembled with model airplane cement, was used for the box, but other stronger and more decorative woods could be substituted, and the box may be any desired size. The figure of the sleeping peon is whittled from white pine and painted in gay colors, and the box is finished in shellac.

This Mexican peon, carved from white pine, can be used to decorate the top of any small box



Small Pins and Pendants Cut from Plastics

HERE are three novelties that make a hit with the ladies and sell readily. The strutting duck and flying pigeon are decorative pins or brooches jig-sawed from brilliantly colored cast-resin plastic, $\frac{1}{4}$ " thick. The eyes are indicated with a touch of the drill.

The birds are given a final high polish by buffing with pumice paste, then with

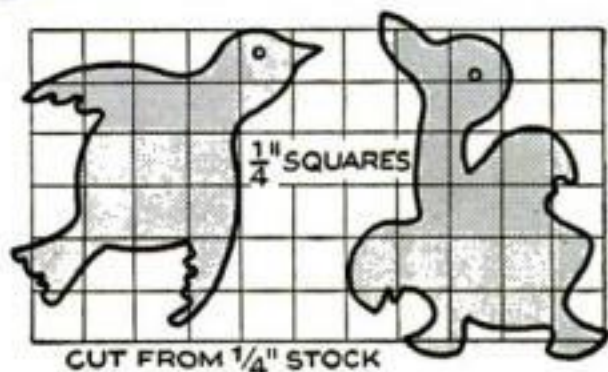
a waxing compound, and finally with a dry buff, as described in previous articles in this series. Regular metal pins and clasps are securely anchored into the material by first drilling holes into the plastic slightly smaller than the pins. The plastic is then heated in boiling water until it begins to soften, and the pins are pressed into the holes.

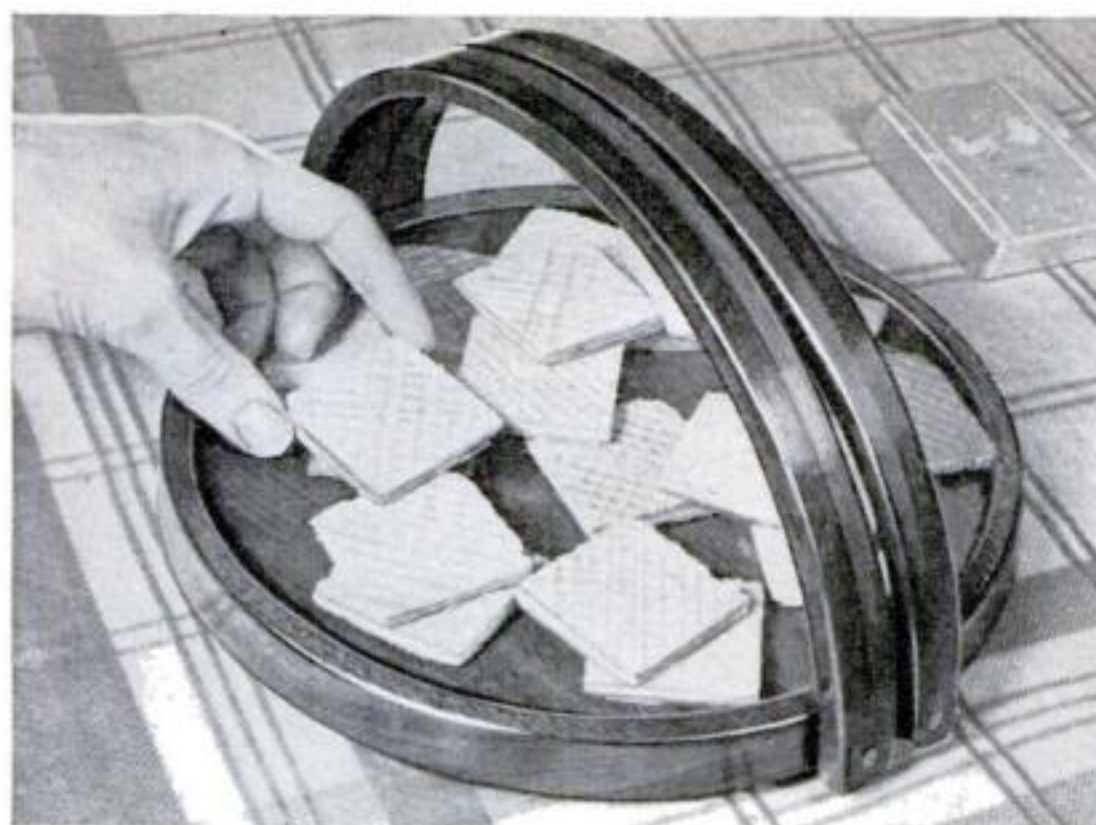
The pendant is sawed from pieces of $\frac{1}{4}$ "

plastic, one transparent and the other white and translucent. A tiny decalcomania transfer, paper silhouette, or photograph is placed between them, and they are fastened together with clear cement. When dry, the pendant is ground to the finished shape with a hand motor grinding tool, and the gold-plated eye is added. All designs are from the Metropolitan Junior Achievement, New York.



Novelties of these types are excellent gifts and can also be sold quite readily





Walnut Tray and Handles Sawed from One Piece

JIG-SAWED from one piece of walnut, this attractive tray with its folding handles is suitable for serving cookies and candies. Cut out a 10" circular piece, then set the jig saw at a 5-deg. angle and cut a $\frac{1}{2}$ " wide ring from the circle. Turn the disk the other way up and cut off another ring of similar width. Raise the second ring and glue in place to form a $\frac{3}{8}$ " rim. Saw the first ring lengthwise through the center and glue the two resulting rings together so the grain runs the opposite way. When dry, cut the two-ply ring in two and attach the handles with small screws. Fill the wood and finish with two coats of spar varnish so it can be wiped clean at any time with a damp cloth.

Cutting a ring with jig saw at a 5-deg. angle. Below, sawing the ring in half



COLORING COPPER BROWN

[METAL WORKING]

The simplest and most universally used method of obtaining a brown finish on copper is as follows:

Dissolve a piece of liver of sulphur (potassium sulphide) the size of an English walnut in two quarts of water. Dip the clean piece of copper that is to be colored into the solution and leave until a dark brown color has been obtained. Remove, wash and let dry. If 1 oz. of caustic soda is added to the liver-of-sulphur solution, the finish will be more or less permanent.

After either solution has been used, the high lights should be burnished, after which a coat of lacquer is applied.

Keep in mind that this treatment will work only on copper.

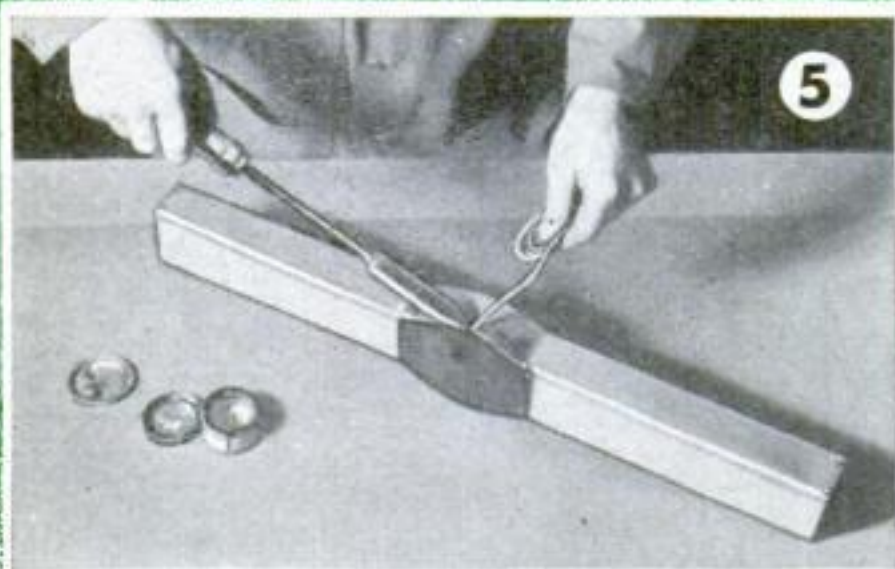
POPULAR SCIENCE MONTHLY SHOP DATA FILE

NOW YOU CAN
BUILD YOUR OWN

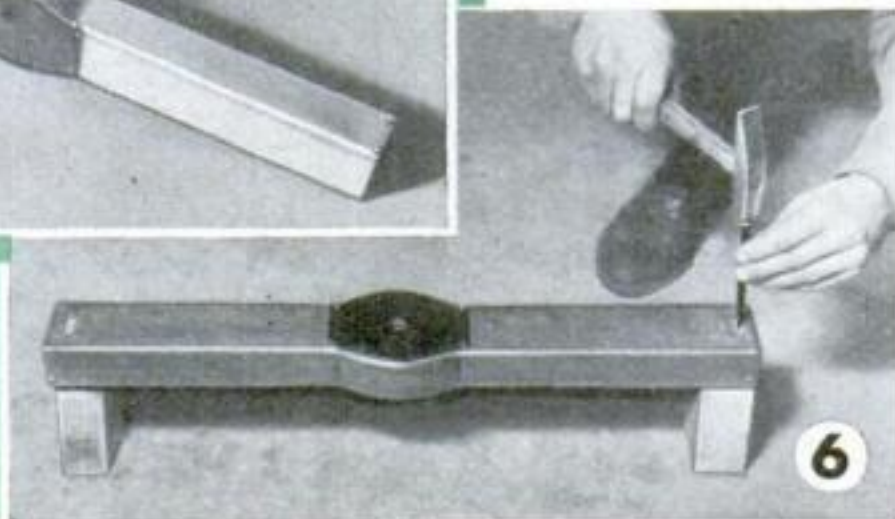
Fluorescent



A game room is among the places where fluorescent illumination is very desirable



Special fixtures are easily constructed. Here are the first steps in making the one shown in Fig. 11

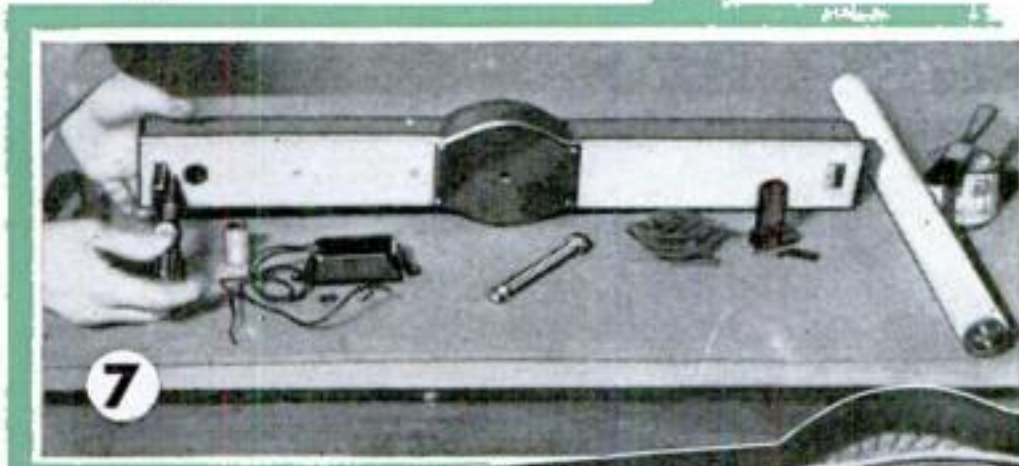


IF YOU are handy at sheet-metal work, you can easily construct fluorescent lighting fixtures at a saving in cost over commercial ones. In this way you can take advantage of the finest illumination available for home lighting. Fluorescent tubes are not only the closest approach to daylight that science has developed for practical, everyday applications, but they produce a relatively cool light and, strangest of all, they are more economical in current consumption than ordinary electric lamps.

The fixtures can be used in many places about the home. Here are a few suggestions: Kitchen—ceiling light; over sink or worktable; over working top of kitchen cabinet; in dining alcove. Workshop—over bench or for general illumination. Game room—over table-tennis or billiard table. Laundry—ceiling light. Living room—in alcove or

elsewhere to illuminate a painting, the piano, a reading table, or other important piece of furniture. Bathroom—twin vertical wall fixtures. Bedroom—twin fixtures for dressing table. Hall—twin fixtures beside mirror. Other rooms—

PART ONE By HAROLD P. STRAND



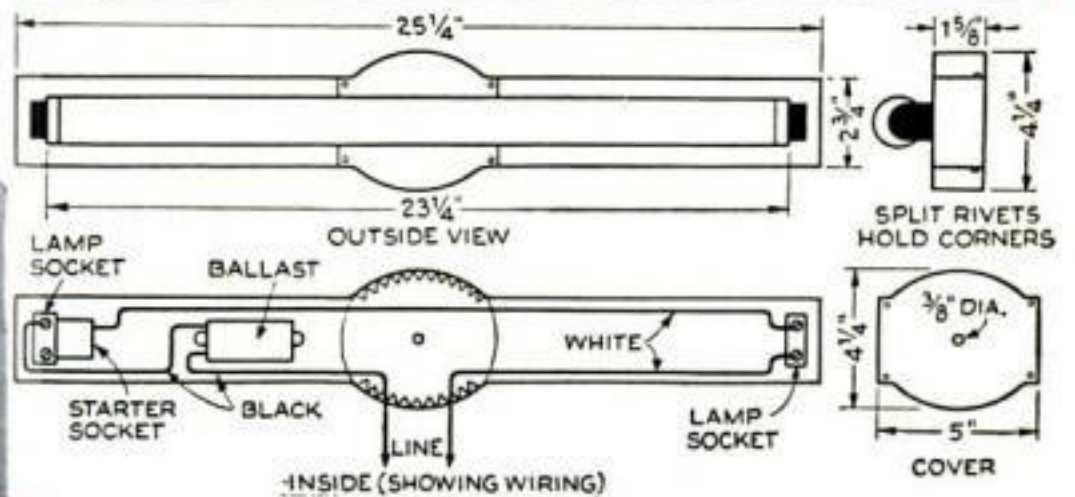
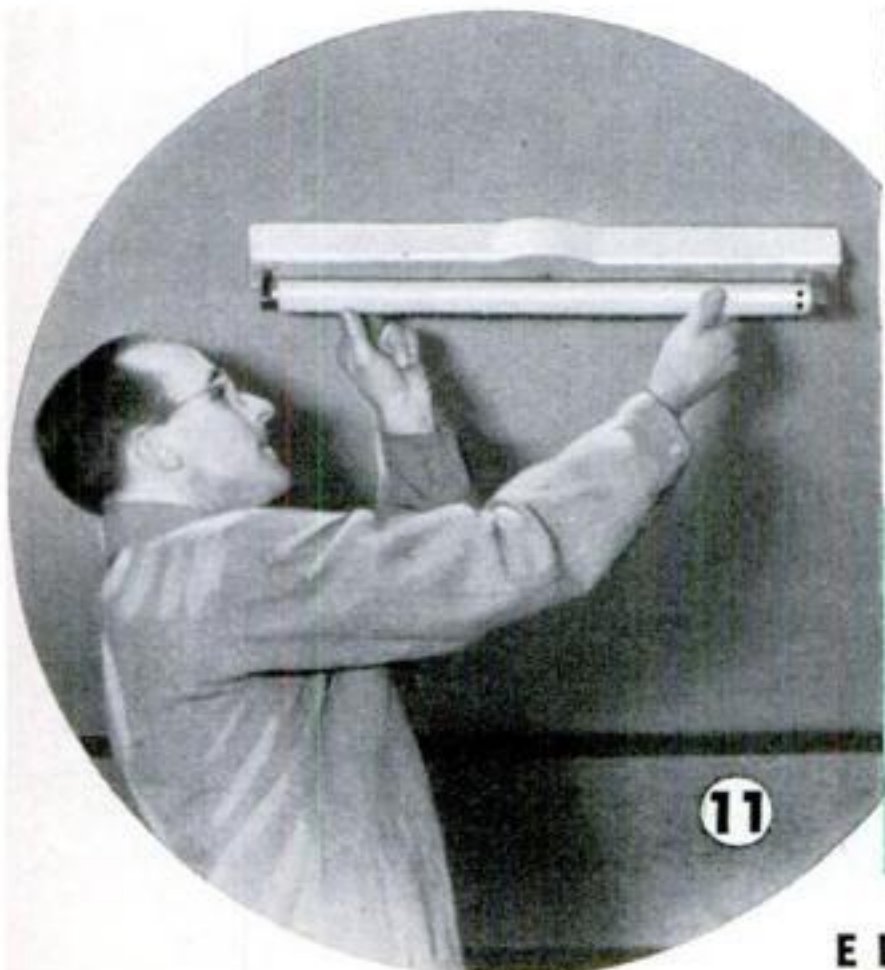
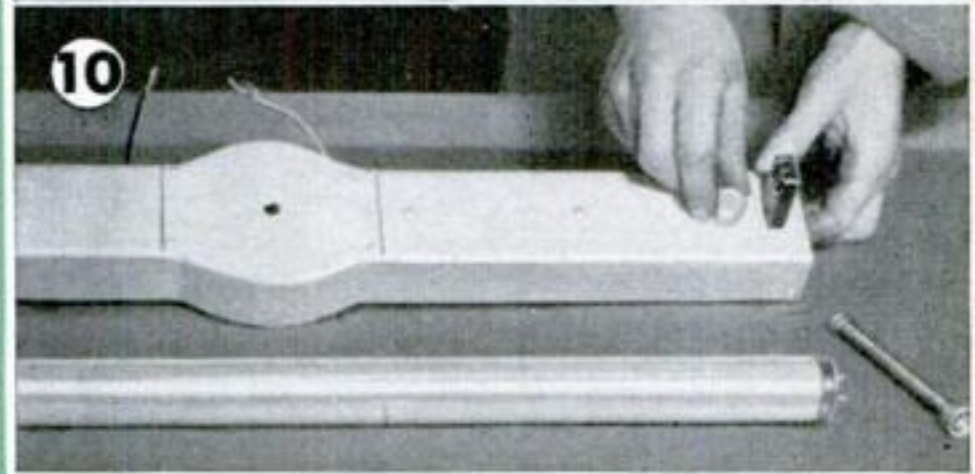
All the parts ready for assembly are shown at the left. Below is the underside with lamp sockets, starter socket, and ballast



indirect illumination obtained by placing tubes back of decorative valances over windows where they cannot be seen.

In a ceiling fixture for a room of ordinary height or with a low ceiling, the channel section can be placed directly on the surface of the plaster. This type of fixture is illustrated in Fig. 11 and drawings A, B, C, and D. For high ceilings a hanging fixture is used, and this will be described later.

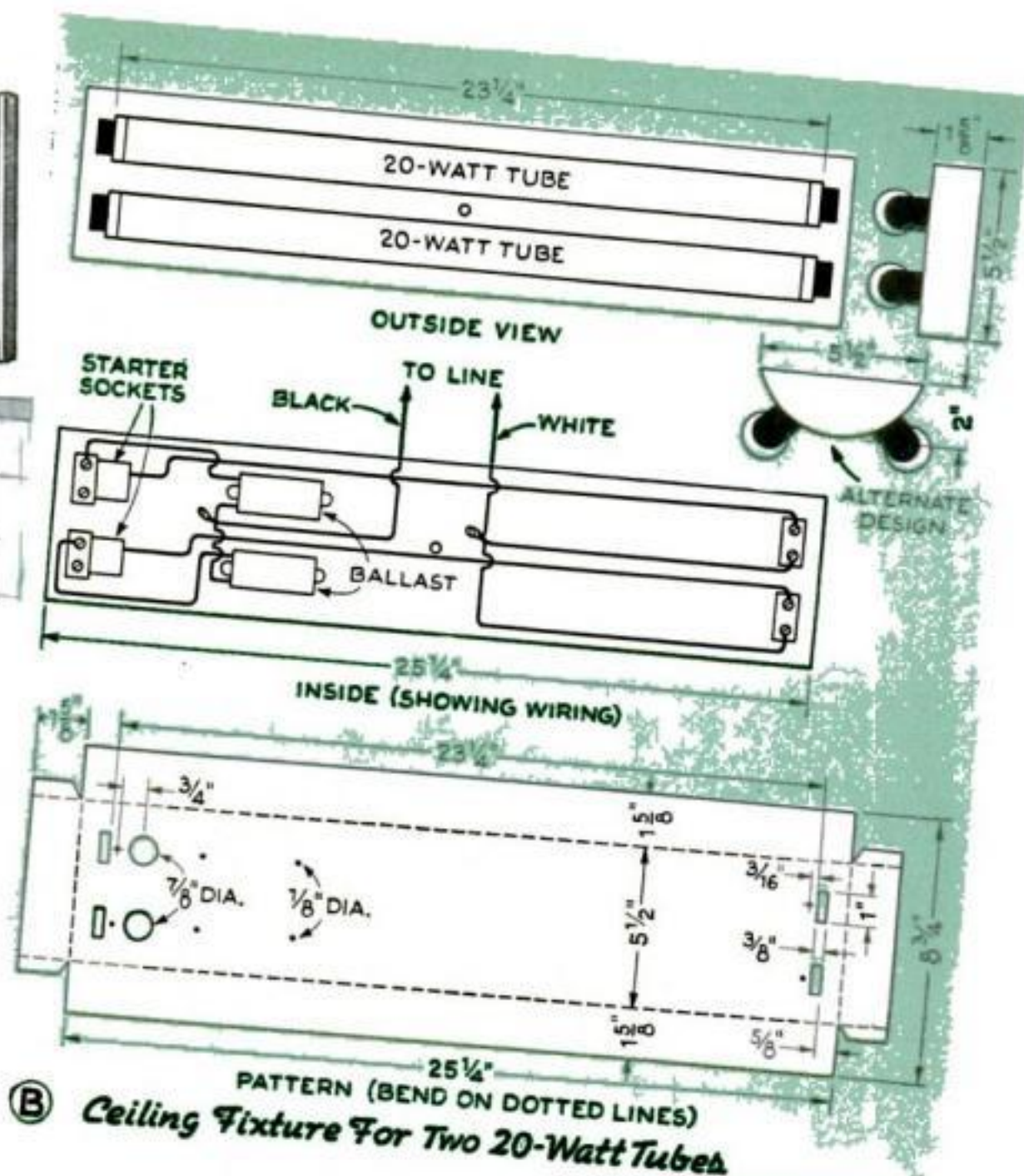
The illustrations marked Figs. 1 to 10 show steps in making a typical fixture (drawing A) with a single 20-watt tube designed to be



(A) Ceiling Fixture For 20-Watt Tube
ELECTRICAL



In the bathroom, twin vertical fixtures may be used to flank the mirror over the washbasin



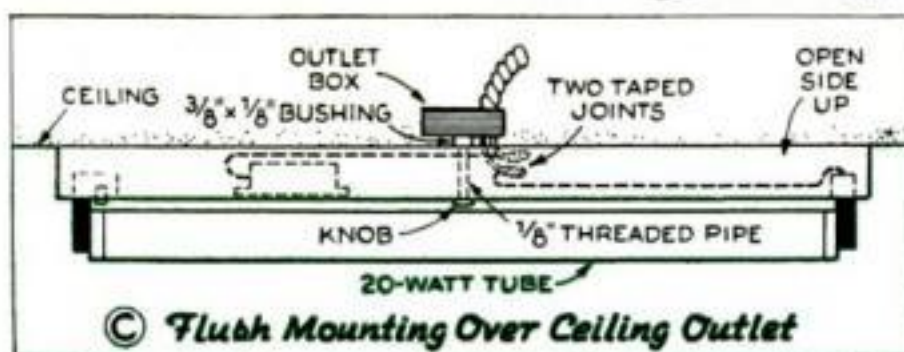
B Ceiling Fixture For Two 20-Watt Tubes

placed over and conceal an existing ceiling outlet. This installation, made in a small kitchen, provides excellent light with a "white" type tube. About 6 watts are lost in the controlling apparatus, so 26 watts are used altogether. Compare this with any other type of electric light and you'll realize the great economy of fluorescent lamps.

The first step in making the fixture is to lay out the pattern, as in Fig. 1, on 22-gauge galvanized iron (or 20-gauge if you have equipment to work metal that heavy). Place a flat piece of metal underneath and cut the large center hole (Fig. 2). The bending can be done by using a 2" hardwood plank and nailing a $\frac{7}{8}$ " by 2" strip on the edge to hold the metal as in Fig. 3. The ends of the channel are bent over the end of the plank and held with a single split rivet in each top corner.

Now grasp the center section and pull it into a $4\frac{1}{4}$ " diameter circle as in Fig. 4. A block of that diameter can be inserted and the metal hammered to a well-rounded surface. This will shorten the channel to $25\frac{1}{4}$ ", which is correct. The cover is attached with four small copper rivets, and a line of solder applied along the joint (Fig. 5). File this to make an invisible joint.

Stand the channel on two short hardwood



Not only is fluorescent lighting ideal for general illumination in a kitchen, but small tubes can be used for special lights

blocks, end grain up, and cut holes for the sockets and starter as in Fig. 6. First, however, outline the circle for the starter with drilled holes. Finish with a file.

The materials ready for assembly appear in Fig. 7. The starter socket is attached to one socket with the long brass screws provided, which replace the short screws normally used with the socket. This combined unit is pushed through from the open side of the channel and secured with the small bolt furnished. The other socket is similarly attached. Then the ballast is fastened to the channel with two small bolts.

In Fig. 8 the channel has been turned over, and the starter socket can be seen fastened to one lamp socket. Only one of the terminal screws of this socket is used for the wire connections, because the other is connected with a copper strap to the starter, placing the two in series. Note the wiring diagram in drawing A.

The completed fixture is given two coats of flat white (Fig. 9) and one coat of white enamel, preferably sprayed. If desired, an aluminum or even a chrome finish can be used. The separate starting switch (Fig. 10) is inserted and removed almost as easily as a fuse.

In a larger room, more illumination can be obtained by making a similar fixture for two tubes as shown in drawing B. With both types, the open side is placed against the ceiling, and the fixture is held with a $\frac{1}{8}$ " knob, nipple, and reducing bushing, which attaches to the outlet box.

Another design (drawing D) is used where a flush mounting is desired on a

LIST OF MATERIALS

The following are needed for one of the 20-watt ceiling fixtures shown in Fig. 11 and at A in the drawings:

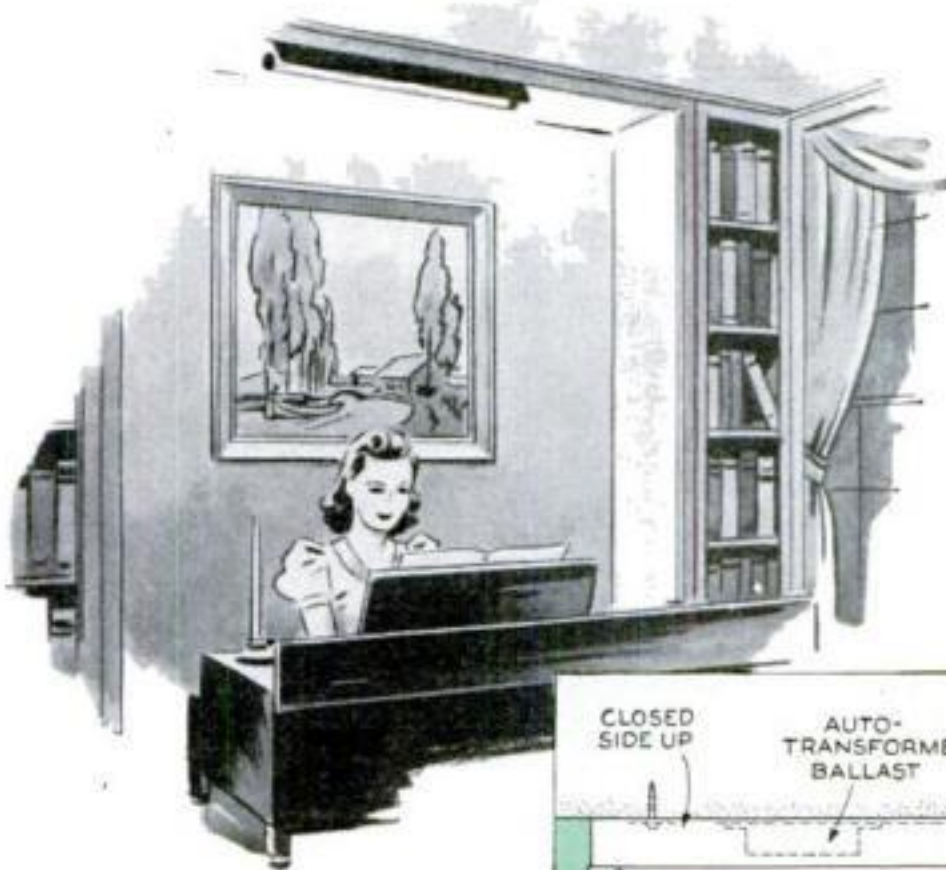
- 1 pc. galvanized iron, 20 to 22 gauge, 29" by 6"
- 1 pc. galvanized iron, 20 gauge, 5" by 4 $\frac{1}{2}$ "
- 4 copper rivets, flathead, about $\frac{1}{8}$ " by $\frac{1}{16}$ "
- 2 fluorescent tube sockets
- 1 " " starter socket
- 1 " " " for 20-watt tube
- 1 ballast for 20-watt tube
- 1 20-watt white or daylight tube
- 2 6-32 machine screws and nuts for securing ballast
- 1 pc. $\frac{1}{8}$ " running-thread pipe about 3" long
- 1 $\frac{3}{8}$ " by $\frac{1}{8}$ " reducing bushing
- 1 $\frac{1}{8}$ " knob or cap, nickel or chrome finish
- 4 small split rivets
- 4 feet No. 18 stranded, insulated fixture wire, white covering
- Paint as required

ceiling, but not covering an outlet already existing. The closed bottom of the channel is secured to the ceiling with wood screws, and the BX is brought in and connected to the channel by an approved connector.

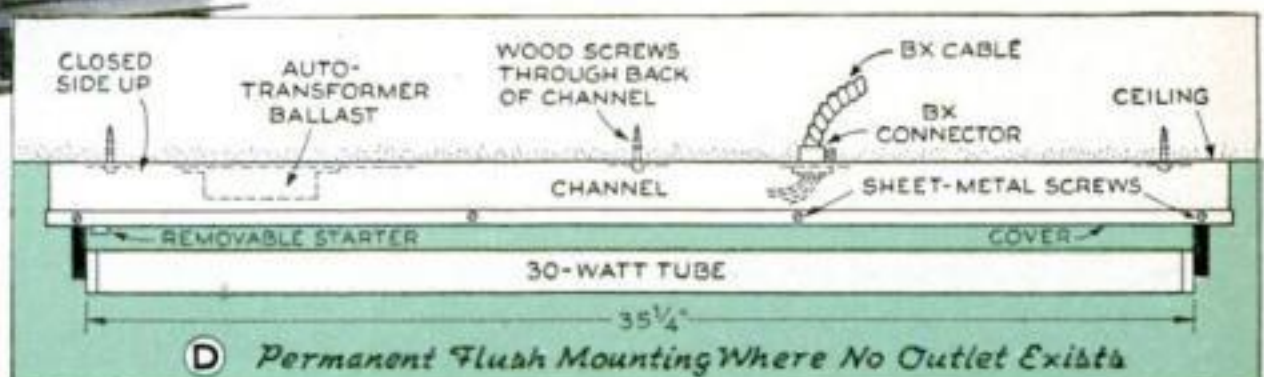
In this case a cover must be made. Some sheet-metal screws through the upturned lip of the cover will secure it. The sockets are attached to the cover by making the required openings to fit the length of the tube selected. The ballast or auxiliary, as the case may be, is mounted on the back section with two small bolts before attaching the completed fixture to the ceiling.

Fixtures for 20-, 30-, and 40-watt tubes are made the same except for the spacing between the sockets. The 20-watt tubes require but a simple ballast or choke, while the 30-watt and 40-watt tubes must have an auto-transformer type of ballast unit for 110-115 volts. Also, nothing lighter than 20-gauge metal should be used for the 30-watt and 40-watt fixtures to insure rigidity.

(TO BE CONCLUDED)



A fluorescent tube will provide daylight illumination for a painting, or for a piano, desk, or table

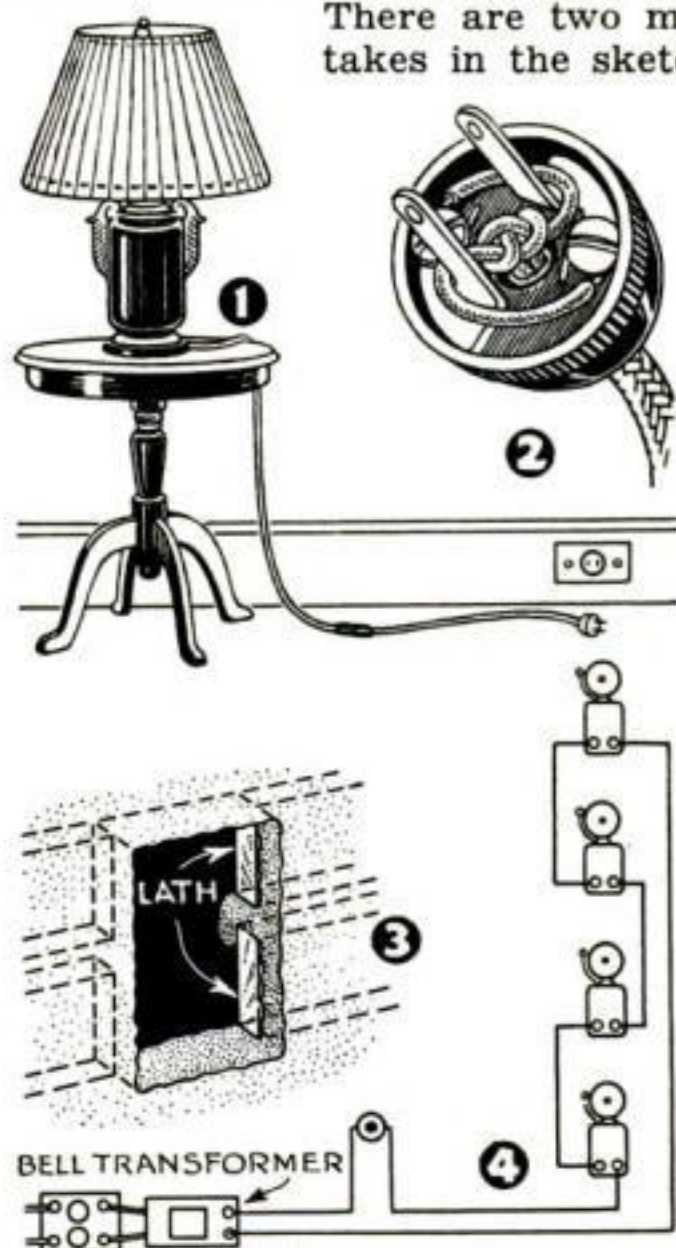


What's Wrong? IN THESE SKETCHES?

SIX mistakes are shown in the accompanying drawings. The answers appear below, printed upside down.

Figure 1 shows a new lamp, the cord of which was too short to reach the outlet. This was remedied by splicing on an extra piece and taping the joint neatly. The attachment plug in Fig. 2 has not been connected to the cord in the approved manner; in fact, two things are wrong. Figure 3 illustrates a hole cut in a lath-and-plaster wall for inserting a switch box. The wiring diagram in Fig. 4 represents a proposed method of installing a bell on each of four floors so all will ring at once when the button is pressed.

There are two mistakes in the sketch.



1. Never splice a lamp cord to make it longer. Electrical inspectors and good electricians consider it bad practice. 2. Carry each wire around the blade to which it is connected to eliminate the possibility of a short circuit. Also, turn the wire around a screw to the right so that tightening the screw does not tend to open the loop. 3. Cut a switch box in a plastered wall so that one lath is cut off entirely in the center and a half lath at the top and bottom. Then the box screws and a good hold. 4. An ordinary bell transformer of about 5-watt capacity will not be able to ring four bells connected in series. Bells for such a system are usually connected in multiple; and a heavier-duty transformer is required.



One Shop Extension Cord Serves Many Purposes

THE necessity of buying several lengths of expensive heavy-duty, rubber-covered shop cord for electrical tools and appliances can be avoided by using one piece with the usual plug at one end and a connector at the other, as illustrated. Each appliance then requires only a short cord and plug. Not only is the expense reduced, but time is saved in changing from one appliance to another.—CLINTON R. HULL.

Insulation Strips Easily After Being Hammered

A QUICK, effective way of removing ordinary insulation from solid or stranded electric wires is to lay the wire ends on a piece of metal, stone, or even hardwood, and strike them several times with a hammer.

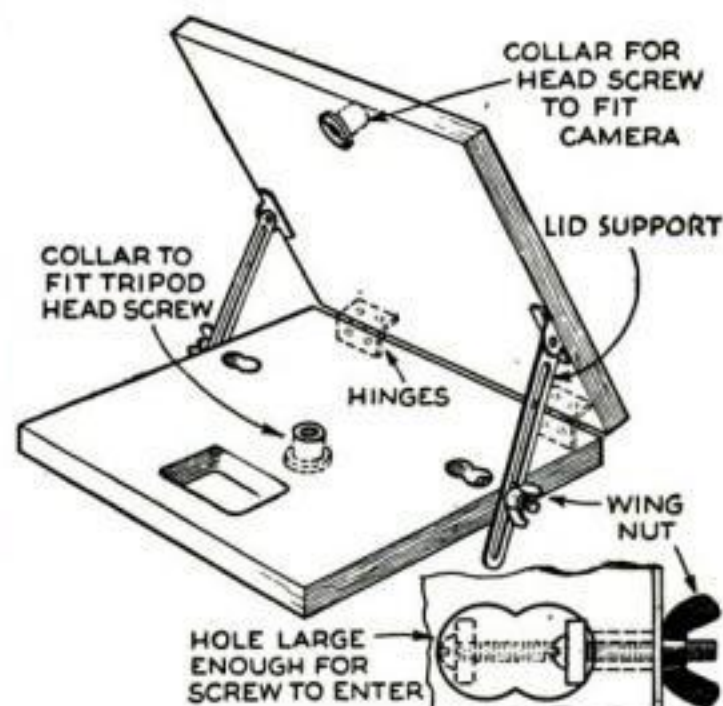
This splits the fabric-and-rubber covering, making it easy to remove, but does not damage the wires.



Soaped Electric Wires Slip Through Conduits



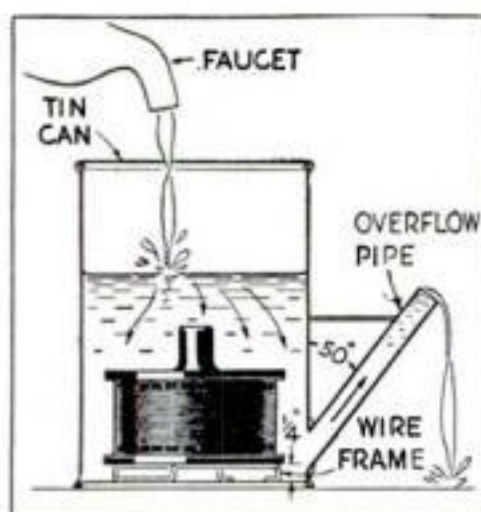
SOAP from a dry cake, if rubbed on the insulation of electric wires, will enable them to be pulled more easily through conduits and other openings. It acts as a lubricant, but does not harm the wires.



Substantial Camera Tilt Top Is Easily Built

WITH this homemade swing top, a photographer may tilt his camera through an arc of 90 deg. The materials: 2 pc. hardwood, $\frac{3}{4}$ " by 6" by 8"; 2 small brass hinges; 2 lid stays, 6"; 2 machine screws, 6-32 by 2" long with nuts and thumb nuts; 1 tripod screw to fit camera and 2 tripod-screw col-

lars, obtained from a camera store. The tripod collar for the screw with which the camera is fastened must be placed towards the back of the swing top, but the other tripod collar (the lower one) is centered. A recess is cut into the stationary base to receive the head of the camera screw.



Washing Roll Films Efficiently

VERY few amateurs who use roll-film tanks have an efficient method of washing the film after the hypo has been poured off. The washer shown, however, draws off the heavy, hypo-laden water from the bottom and automatically maintains the water level above the film reel. Materials required are a tin can with the top smoothly removed by a can opener of the rotary type; a $3\frac{1}{2}$ " length of $\frac{3}{8}$ " brass or copper tubing; a piece of No. 10 copper or other suitable wire, and special photographic paint.

FILTER CHARACTERISTICS

[PHOTOGRAPHY]

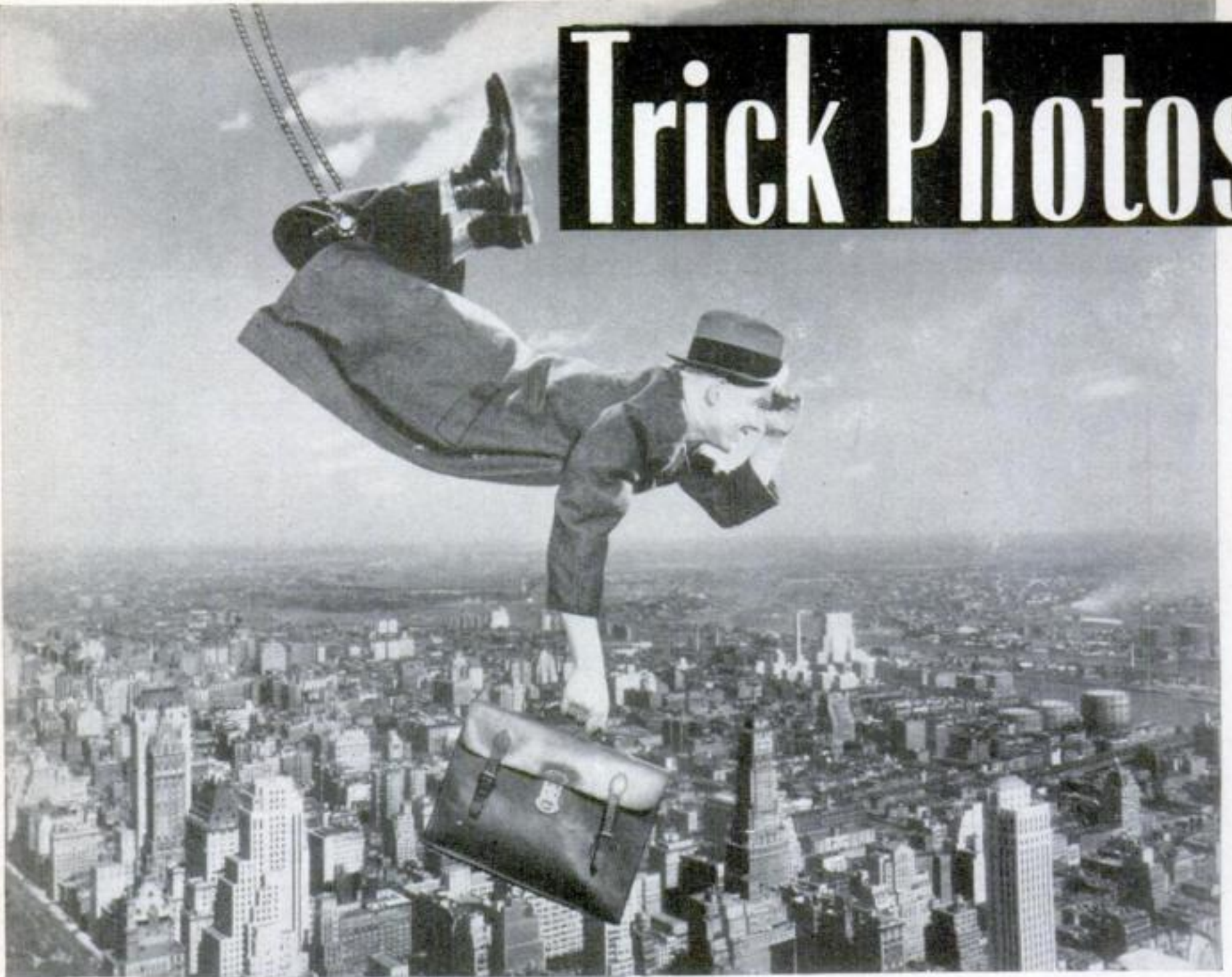
In the following tabulation the headings "darker," "black or nearly black," "lighter," and "white or nearly white" indicate how objects of the colors noted below them will appear on panchromatic film with filters of various colors in comparison to their appearance on the same film without any filters.

Filter color	1. Darker	2. Black or nearly black	3. Lighter	4. White or nearly white
Red.....	Green and blue-green	Blue	Orange	Red
Green.....	Orange	Red and deep red	Blue and blue-green	Green
Blue.....	Yellow to orange	Red	Blue-green and violet	Blue
Yellow.....	Blue and violet	Deep violet	Orange and yellow-green	Yellow
Violet.....	Red and orange	Deep red and true yellow	Blue-green	Blue through violet

It will be noted that in columns 1 and 2 are the colors held back or absorbed by the filter, while columns 3 and 4 are the colors passed or transmitted by the filter. Example: If it is desired to copy red printing to appear black, refer to column 2 and note red, then read the filter color in the left-hand column, which is blue. Since there are many makes of filters and films, the characteristics of which vary, only the color of filters is given. The table applies only to panchromatic films.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Trick Photos

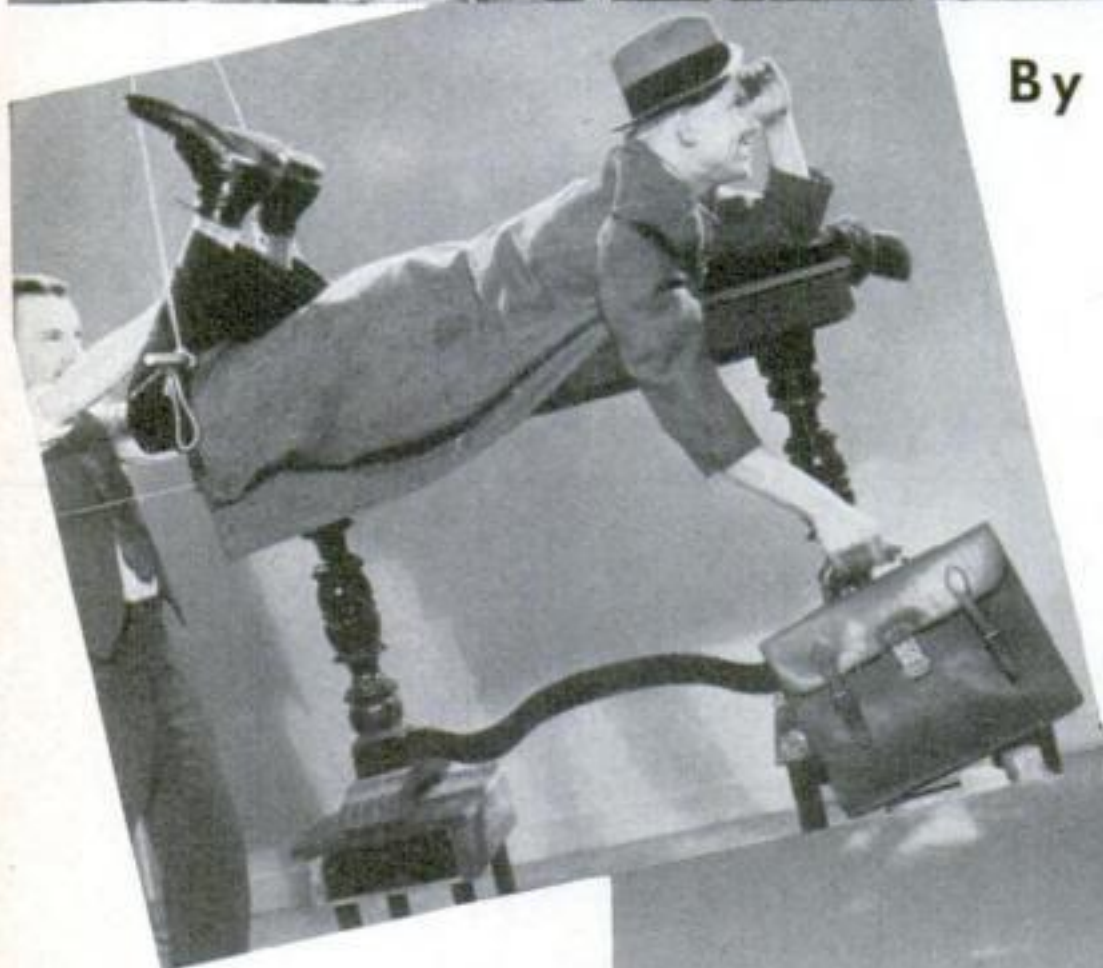


By **FRANK CAPORAE**

YOU can produce all sorts of amusing photographs by learning a simple technique known as "stripping in." It is one the professional photographer frequently uses in creating spectacular pictures.

As many photographs as desired may be used, but it is important to have the direction of the light the same in all. The example illustrated required only two pictures.

After you have selected the subject, make suitable glossy prints and finish them in the usual way. A single print is sufficient of the one picture that is to serve as a background, but it is best to make several prints of the ones that are to be pasted on it. That



The two photos and, above, how they appear when combined. In taking the man's picture, the light was arranged to conform to the other print. Note how the coat was held out to look as if it were blowing. An assistant helped the model keep his legs in the correct position

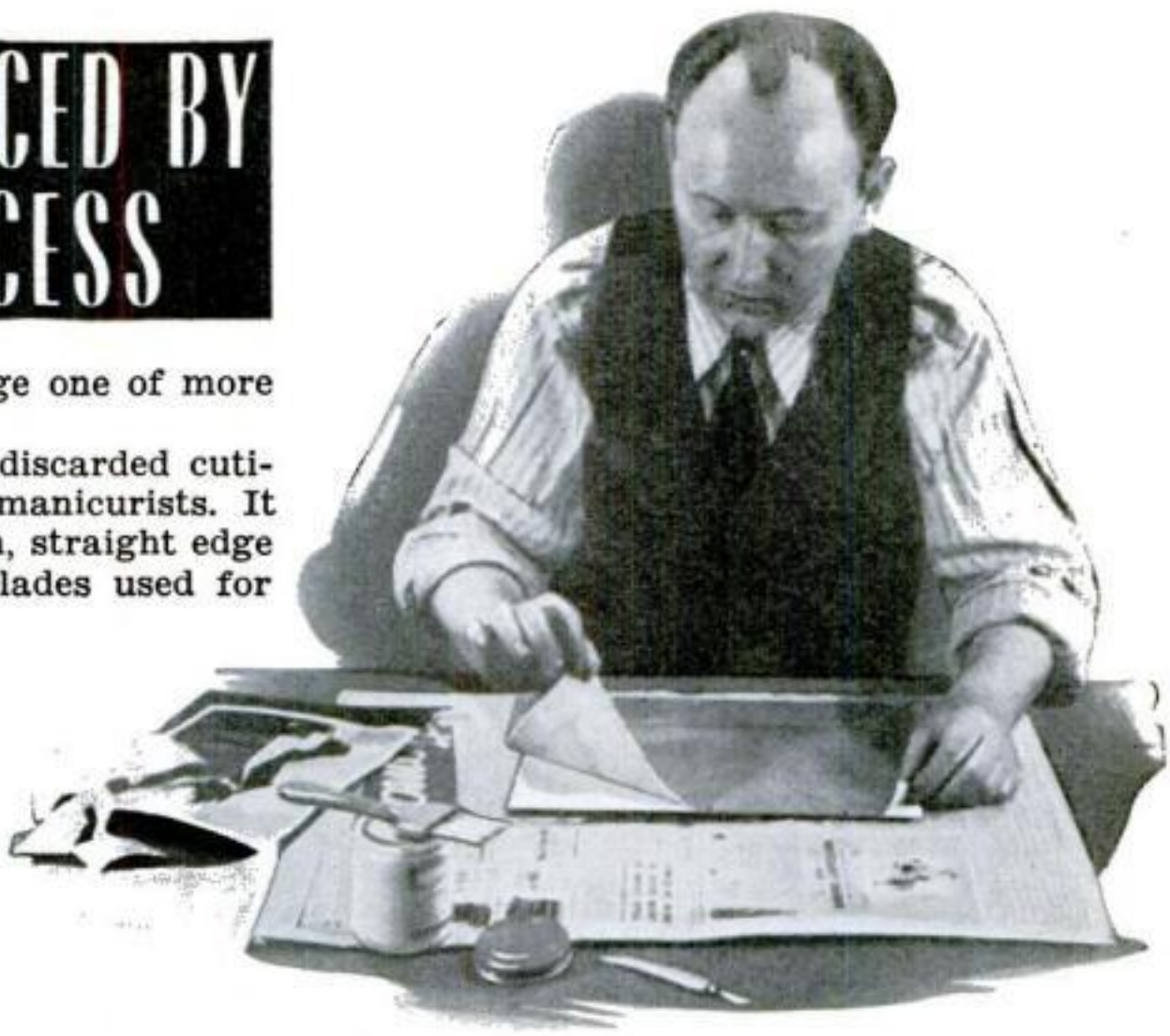


EASILY PRODUCED BY STRIP-IN PROCESS

is because a slip may damage one of more of the prints.

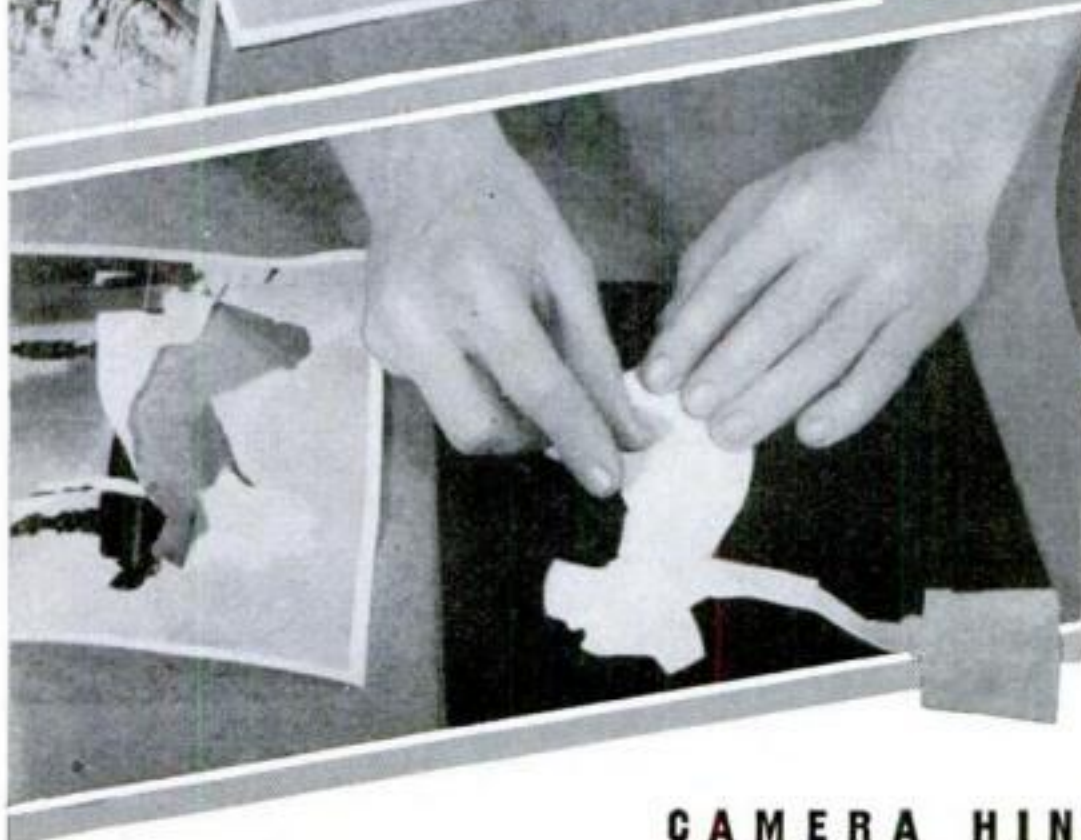
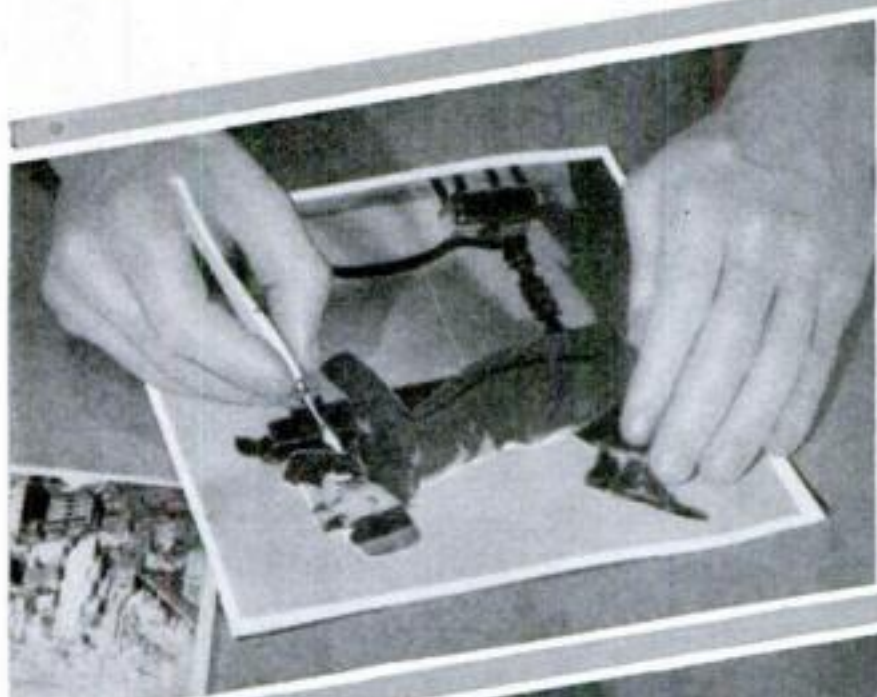
The knife illustrated is a discarded cuticle knife such as is used by manicurists. It has been sharpened to a keen, straight edge with a very sharp point. Blades used for linoleum block cutting or similar knives may also be used for this purpose.

The cutting must be done very carefully. Follow the extreme edges of the figure to be used, and cut the photographic paper only to the depth of the emulsion. The blade should never be allowed to penetrate all the way through the paper because that would leave a



Before mounting the background print, paste a piece of wrapping paper on the back of the cardboard to counteract warping

First, cut the edges with a sharp knife, but only through the emulsion—not the paper. Second, peel the cut-out itself from the backing paper



Third, turn the cut-out over and smooth with very fine sandpaper. Fourth, blacken the edges on the back with waterproof drawing ink

very noticeable edge in the finished picture.

After the outline of the figure has been completely cut around, the strip-in is removed from the base. This is accomplished by starting to tear in from the edge diagonally toward one part of the line marked by the knife. At the same time, bend the waste part backward. In this manner the cut-out may be literally peeled off the backing paper. The paper itself splits, a thin layer remaining on the cut-out. Care should be taken to keep the edges of the strip-in as thin as possible. Leave no lumpiness near the edges because even slight unevenness will cause a ridge that is clearly discernible on the final picture.

To assure perfect contact, the cut-out portion should be sandpapered slightly on the back. This should produce a smooth, even surface, tapering toward the edges.

When the edges are satisfactorily reduced almost to the thickness of the emulsion itself, apply waterproof ink to the edges of the cut-out. If there remains any white fuzz after the cutting and tapering, the ink will cover it. This is best done with a small paintbrush of the type used by artists.

The background print must now be mounted. Any piece of smooth-surfaced

cardboard, if slightly larger than the print, will answer the purpose.

Before mounting the print, soak in water a piece of strong wrapping paper the same size as the mounting board. Apply a good grade of office paste to the back of the mount and put on the wet wrapping paper. Smooth it out so that there are no air bubbles, preferably with a squeegee. Now take the background print, after soaking it in water, and apply it to the opposite side of the mount in the same manner as the wrapping paper. The paper backing will keep the cardboard mount from curling when the print dries.

Next soak the strip-in in water. When it is thoroughly wet, paste it on the background print. Take a piece of cotton and smooth the entire layout, forcing out all air bubbles to the edge of the paper.

When dry, any necessary retouching may be done, such as that which was necessary on the trapeze cords in the example illustrated. All that is left to do is to copy—that is, photograph—the finished paste-up. If properly done, the difference between the background and the strip-in is unnoticeable. The finished view will look exactly like a single picture.



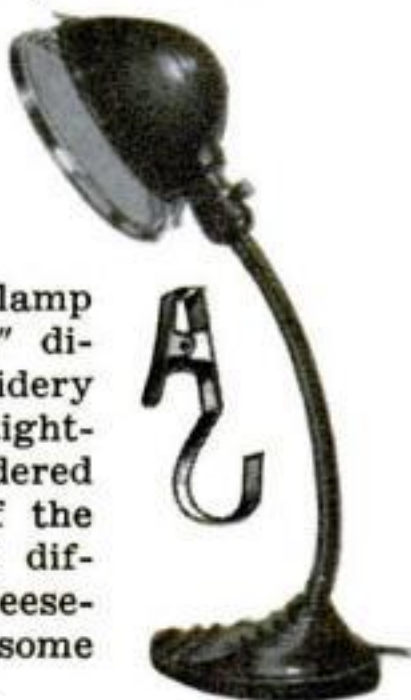
Cable Release Has Good Grip

CABLE release grips are slippery, especially in the summer when hands perspire, and many pictures have been lost because of this. An ordinary fiber

water-faucet washer, if slipped over the cable and pressed tightly on the shaft, will afford a firm grip.—SIDNEY R. BAYNE.

Diffusing Screen Clips on Small Lamp Shade

GOOSENECK desk lamps are often used as photo lamps, in which case the bulb is replaced with a No. 1 photoflood. A handy clip-on diffusing screen for such a lamp can be made from a 7" diameter metal embroidery hoop with a couple of straightened-out hook clips soldered to the inner surface of the smaller hoop. For the diffusing medium, use cheesecloth, tracing cloth, or some similar material.—A. T.



Camera-Accessories Case Quickly Rearranged

YOUR camera-accessories case will be more adaptable to various purposes if you use removable partitions instead of stationary boards or webbing. The case illustrated is arranged for synchro-flash work, but by removing the horizontal partition, it will hold photoflood reflectors, bulbs, and camera, or I can place the camera and synchronizer in it all hitched up.—J. FRASER.



IT SUBMERGES, RUNS UNDER WATER, TRAVELS ON THE SURFACE, AND REPEATS AUTOMATICALLY

WITH school days over and warm weather calling, what mill-pond armada won't welcome the active addition of a model submarine that really works? It is made of tin cans, wire, and odds and ends, and powered by calcium carbide at fifteen cents a pound.

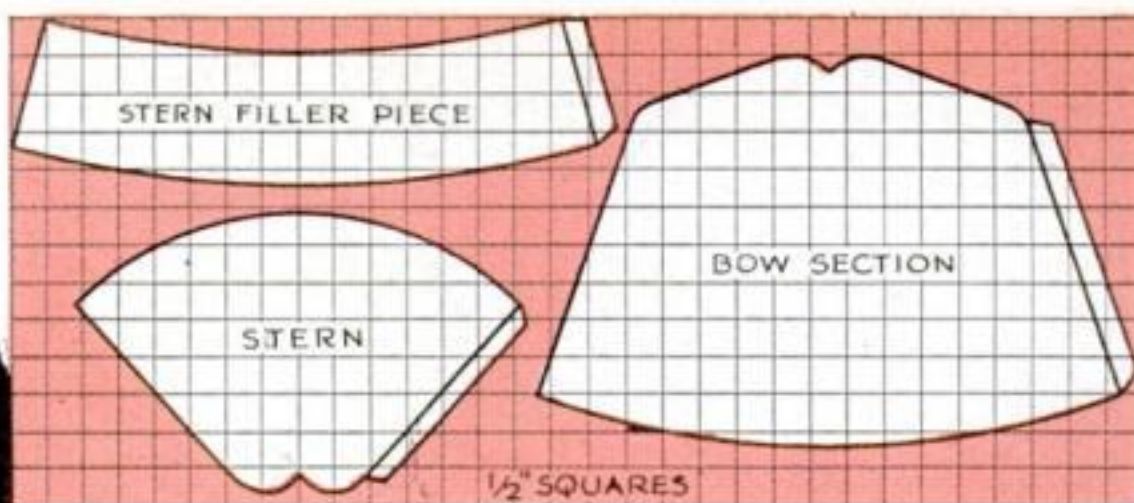
Two simple valves allow water to enter the central part of the hull until the model goes down. At the same time water reaches the carbide, and the generated gas pressure closes the valves tightly and forces the water out through a propulsion tube. This drives the boat rapidly ahead and restores its buoyancy so that it comes to the surface. The cycle is then repeated, and one charge lasts for several runs.

Each half consists of a small soup can with its bottom in and the top rim intact, and a shaped tin bow or stern trimmed to fit inside the rim of the soup can at the end which is intact. Solder the part on to form an air-tight compartment. In closing and soldering the extreme bow and stern, insert a strip of tin and solder to this, then trim

to shape. Fill in irregularities with solder.

The conning tower is a small paint can or plastic composition wood can with a friction lid. It is through this that refueling is done. Cut the bottom off and trim so that the conning tower fits saddle fashion on top of the bow section. Mark around it and cut out the soup can so that the conning tower fits just through the hole. Scrape everything clean, align the conning tower with the bow, and solder.

Now make the water intake valve. If you have an old wooden photographic film spool, remove the metal ends and use them, otherwise make a short tin tube and solder in a $\frac{1}{2}$ " washer. Tin the whole thing with solder, and solder four small wire L's around the hole at least $\frac{1}{8}$ " back from the edge of the hole and with their legs pointing outward. Bend these over the hole about $\frac{1}{4}$ " from the surface and cut off just short of the center so that you have a cage over the washer to retain the valve disk. Cut the disk from fairly thin inner-tube rubber. Solder the valve through a hole punched in



Most of the construction is tin—two small soup cans and flattened pieces of large cans

the bottom of the boat just ahead of the conning tower. Hold it in place on the inside with a damp cloth while soldering.

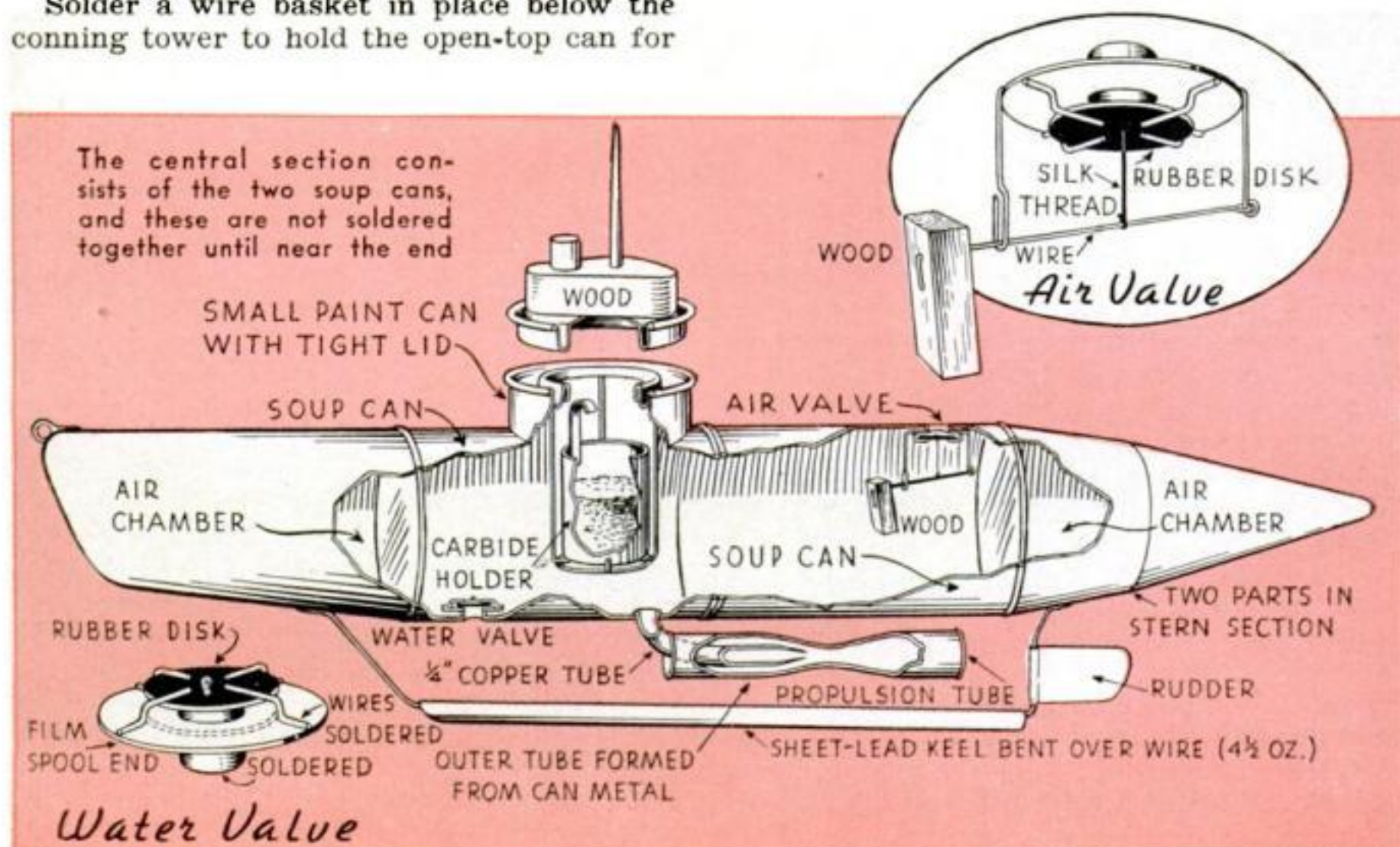
The propulsion tube is a $\frac{1}{4}$ " copper tube about 3" long, curved to extend down and backward from the bottom of the hull near the center. Squeeze the outer end half closed to form a flat jet, and file to a sharp edge all around. Make a 4" length of 1" diameter tin tube, center it over this jet, and solder. Then squeeze this tube just beyond the jet so that it is flattened to about half its diameter.

Solder a wire basket in place below the conning tower to hold the open-top can for

the carbide. This must have a short piece of wire attached for a handle, and its top should come just at or below the level of the air-escape valve. If water doesn't get in, you may have to cut the sides down a little. If it gets in too soon before the sub fills, the model will start off before submerging.

The air valve is similar to the water valve, but a wooden weight is added. This is mounted as shown and is attached by a length of silk thread to the center of the rubber disk. The assembled valve is soldered in a hole through the top of the rear section of the sub. Though the valve weight will operate on the thread alone, it is best to limit its movement by a wire hinge soldered to the valve body so the assembly may be installed as a whole. Use a sewing needle to draw the thread through the valve disk; then, after adjustments are made and everything working, the thread may be secured to the disk by a drop of cement from the outside.

With everything in place, you can solder the two halves together. They are just



Water Valve

butted together at the rims, and solder is flowed freely around the joint.

Bend the wire keel so that it runs just below the propulsion tube and solder it in place. To it, attach a strip of lead or lengths of heavy wire weighing from $4\frac{1}{2}$ to 5 oz. The exact weight must be found by experiment. It should be just enough to cause the submarine to sink when filled with water. The rudder must also be soldered on. If desired, a wire ring may be added to the submarine for a retrieving cord.

Screw and cement a shaped block of wood to the conning-tower lid, to which may be added a toothpick periscope and other details. The wood also will float the lid and prevent its loss if it accidentally falls in the water.

Clean off the soldering flux with washing powder and paint or lacquer the submarine lead color.

In operating the submarine, fill the generator can about half full of carbide. Buy $\frac{1}{2}$ " miner's lamp carbide, which is also used by sportsmen and therefore readily obtainable. If too much is put in, it will boil over the sides of the generator and possibly clog the propulsion tube. Then, off comes the conning tower lid with a bang! But, no harm done. A little grease smeared on the sealing surfaces of this lid will make it easier to operate and lessen chances of leakage.—R. A. C.



Refueling the sub. The small can drops into a wire basket, and the friction lid of the conning tower is put in place



After submerging, the sub rises to the surface for a short cruise at full speed before it again fills and goes down

Strong Tea Antiques Rigging

MODELS of ancient ships look far more realistic when their rigging has an antique appearance. This may be imparted by dipping the "ropes" in strong tea. Allow them to dry before fastening in place.—P. H. S.

Miniature Tires Molded from Liquid Rubber



TIRES for scale models of autos and airplanes cannot always be obtained in the required size or shape. They can be easily made, however, from liquid rubber of the type sold for rubber molds and repair purposes. A half-section mold, slightly smaller than the wheel, is first turned and finished as smoothly as possible from a hardwood or lead block. The liquid rubber is then poured in the mold. About three applications will be necessary because the material shrinks considerably in drying.

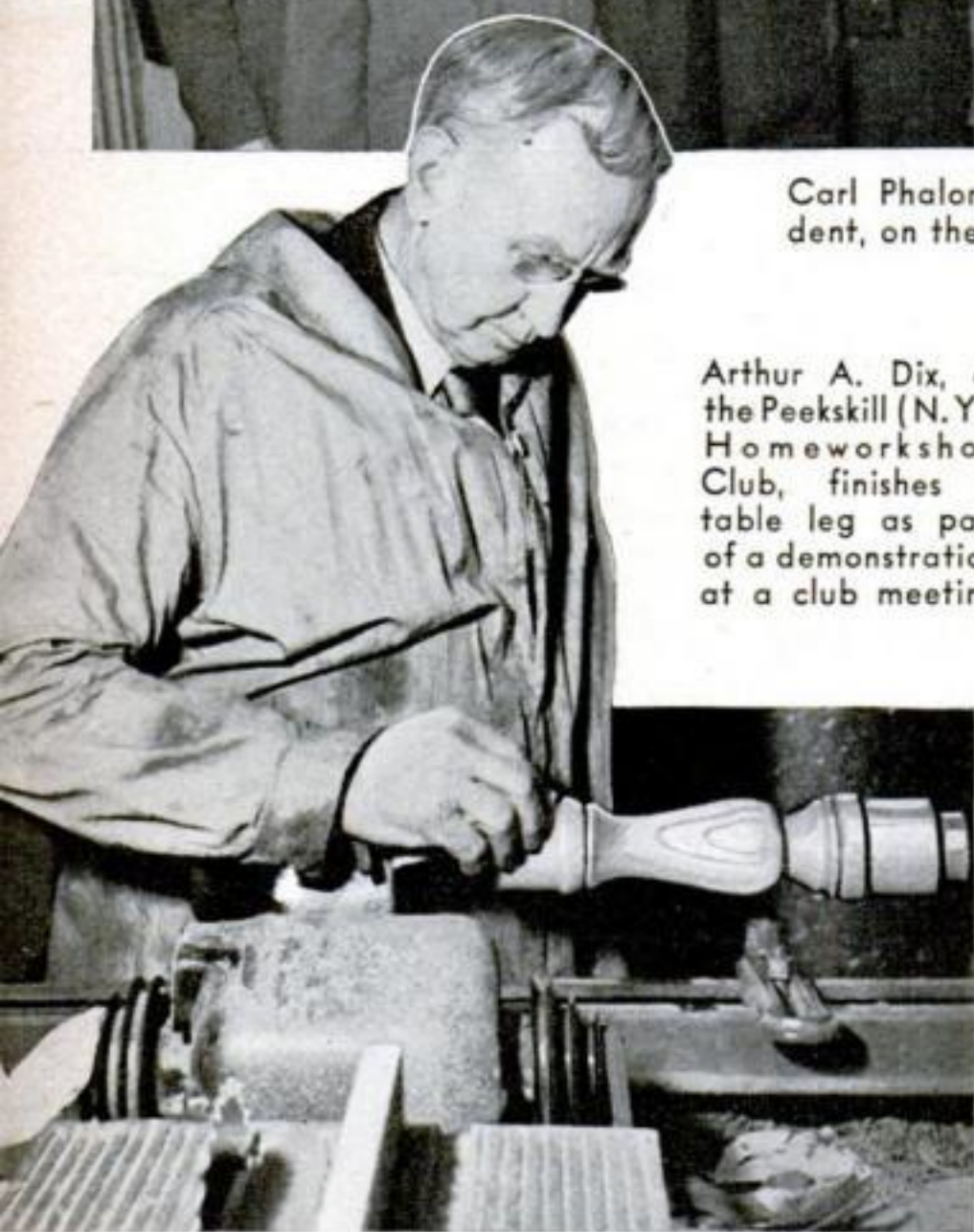
When two halves are made, cement them together with rubber cement; and if the margin is ragged, trim it with scissors. Some liquid rubber is of the pink variety but it can be colored with India ink before being poured.—R. H. MCNAIR.



Guildcrafters



Carl Phalar, left, presents a gift to W. B. Cotton, first president, on the Columbus (Ohio) Homecraft Club's sixth anniversary



Arthur A. Dix, of the Peekskill (N.Y.) Homeworkshop Club, finishes a table leg as part of a demonstration at a club meeting

the National Homeworkshop Guild, he may participate in more ambitious civic projects.

The *Saginaw (Mich.)* Homecraft Club, for example, recently completed eight teeter-totters and four merry-go-rounds for the two orphans' homes in the city. The members had been informed that the homes lacked the proper indoor play equipment, so they immediately went to work. The cooperation was obtained of local lumber mills and hardware stores, which donated nearly \$100 worth of materials. The equipment was constructed in a boat and house-trailer factory owned by a member.

When the local Audubon Club expressed a desire for bird houses, the *Columbus (Ohio)* Homecraft Club offered to build several hundred. A joint meeting of the two organizations was broadcast over station WCOL. Last year the Homecraft Club made up seventy-five sacks of building blocks and toys to give to poor children.

Four thousand persons attended the sixth annual exhibition of the North Shore Craftsman Club, *Waukegan, Ill.* Considerable interest was shown in the model airplanes made by a junior auxiliary sponsored by the club.

Half of each meeting of the Holabird Homeworkshop Club, *Dundalk, Md.*, is devoted to constructing some small project that illustrates woodworking methods and

F AWARDS were made among hobbyists for unselfishness, amateur craftsmen would receive first prize. Some hobbies bring happiness only to those interested in them, but the home workshop hobby spreads cheer throughout the entire neighborhood. The man who spends perhaps ten or twelve hours each week in his shop not only makes things for himself and family, but also for his friends. If he belongs to a home workshop club, such as the clubs sponsored by

Active in Civic Work

uses of various tools. Each member receives a folder in which to keep printed copies of the minutes and plans. The club shop is open to members four nights a week.

Rare woods were exhibited at a recent meeting of the *Passaic (N.J.) Amateur Craftsmen Guild*. Ernest Nicholson made a frame for the club's charter . . . When the *Spring Valley (Ill.)* Craftsmen met at the home of

Joseph Seville, Harold Walburn spoke on staining and finishing woods, Steve Terando on zinc and its uses, and Daniel Metzinger on welding . . . The *Rehoboth (Mass.)* Homeworkshop Club has added a field-stone fireplace to its clubroom . . . Two members of

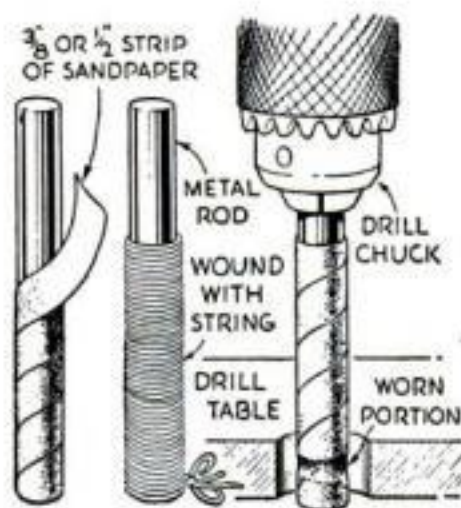
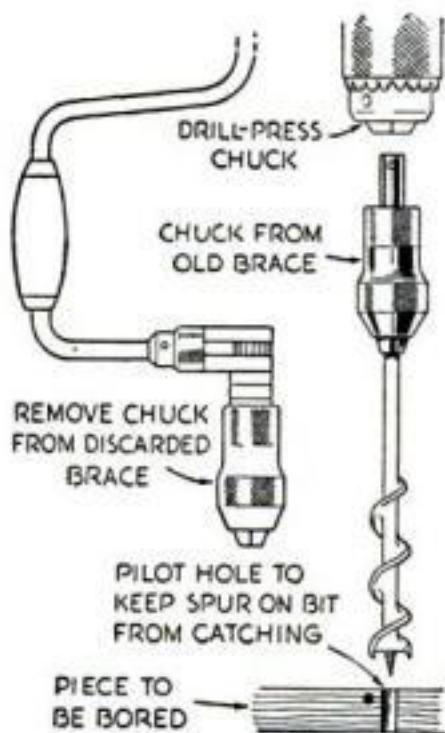


Members of the Columbus club watch E. O. Schlegel give a lathe demonstration. This group of men recently made 200 bird houses for the Columbus Audubon Club

the *Danville (Ill.)* Homeworkshop Club are constructing their own Duncan Phyfe dining-room suites . . . The *Granlea (Alta., Canada)* Homeworkshop Club has made battery-operated telephones so that the members can keep in touch with each other.

Drill-Press Adapter Holds Square-Shank Bits

NOT every home worker can afford an extra set of bits for boring wood in his drill press, but if he can pick up an old brace somewhere, he can make a very satisfactory adapter from it that will enable him to use all his square-shank bits in the press without buying an extra chuck. Simply knock out the pin that holds on the ratchet wheel, and remove the chuck. The chuck has a straight section on it that fits snugly into a $\frac{1}{2}$ " drill chuck. In use, it is best to drill a pilot hole first. This hole should be near enough the size of the screw point to guide the bit accurately, but not small enough to let the threads on the point catch in the wood.



Sanding Rods for Use in Drill Chuck

MANY a craftsman has glued sandpaper around a dowel rod to be used as a spindle sander in his drill press. An improvement is to cut several $4\frac{1}{2}$ " or 5" lengths of metal rod from $\frac{1}{4}$ " to $\frac{1}{2}$ " in diameter, depending on your drill chuck. Brush glue on a strip of sandpaper and spiral it around the rod; then wrap string around it until dry. These make excellent sanders for tight places in jig-sawed work and the like. In sanding thin work, start at one end of the rod and, as the paper wears out, simply move down a fresh portion.—XURY R. SETTLE.

...

WHEN cutting paper with a razor blade, try placing an old blotter under the paper. Because of its texture, the blotter resists cutting more than ordinary paper.—C. L.S.

Gardening



By
RAYMOND B. WAILES

WHAT happens to a seed when you plant it in your garden? Do young plants give off heat as they grow? Can fertilizer actually kill a seedling? By simple experiments with materials available in any home, you can answer these questions and demonstrate many of the interesting facts about the growth and development of the plants in your garden.

Take, for example, the question of geotropism, the tendency of all seeds to reach downward into the soil instead of upward into the air. You can demonstrate this by lining the inside of a jelly glass with a sheet of dark paper, then loosely packing the glass with sawdust or peat moss. Place several lima beans between the paper lining and the glass, and add enough water to dampen the sawdust and leave about half an inch of water standing in the bottom of the glass. After several days, you will see the radicles, or young roots, sprout out and start their movement downward toward the moisture below.

Another experiment will show the tremendous force that seeds can exert as they begin their growth. Fill an ordinary tumbler almost to the top with beans or dried peas. Add half a tumblerful of water and place a large cork on top of the seeds. Weight the cork down with a rock. When the seeds start to absorb the

These two glasses contain moistened peat moss, and there are germinating seeds in the one at the right. Thermometers show that the growing plants give off heat



Force exerted by sprouting seeds in this tumbler causes the stone to be rolled off

The test below shows how plants drink water. See the difference in water levels



Experiments

IN THE HOME LABORATORY



Moisture escapes from plants through their leaves, as proved by droplets condensed inside the jar in the simple experiment above



The sprig of celery on the right is the victim of overfeeding. Too rich a solution of plant food made it wither and die



Geotropism, the strange force that makes the seed rootlets go downward, is illustrated by lima beans in a jar. Position of the seeds doesn't matter

water and grow, they will swell up sufficiently to force the rock to fall from its perch.

This absorption of water by seeds, and later by the growing plants, is a fact well known to every one, but many persons do not realize that plants also give off moisture. To demonstrate this, thrust the leaves of any small plant into a dry, wide-mouth bottle or fruit jar, and then stop the jar mouth with a sheet of cardboard in which a slit has been made for the plant stem. When this set-up is exposed to the sun, you will soon notice tiny drops of water forming on the inside surface of the jar. These drops are formed from the water vapor exuded by the leaves.

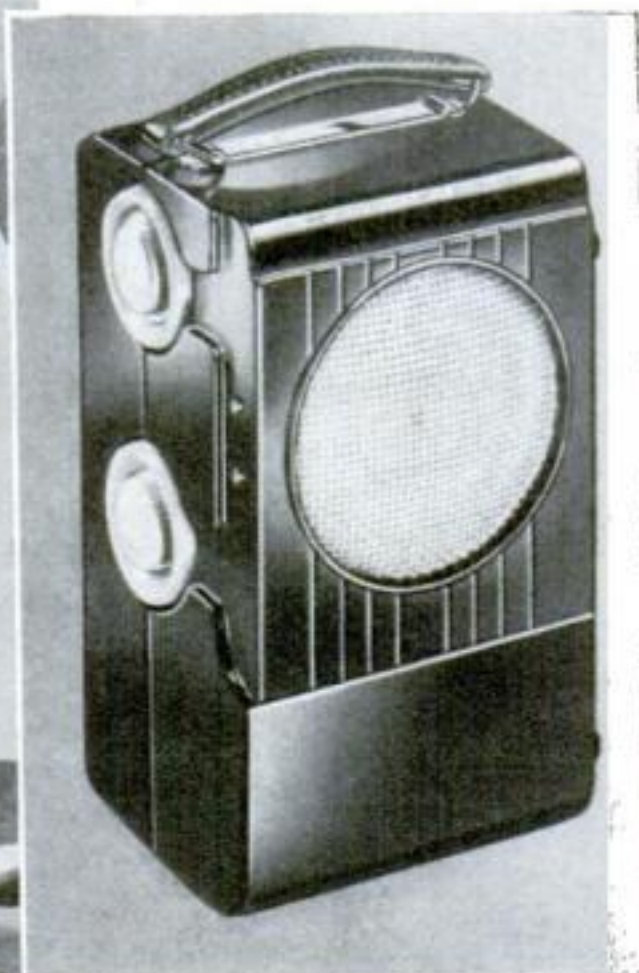
For further proof that moisture in soil flows up through plants and escapes by way of the leaves, use a slotted square of cardboard to stand a small growing plant, with its roots freed of soil, in one of two glass tumblers. Place another cardboard square over the other tumbler. Fill both glasses with water and then squirt a film of oil over the surface to prevent any water from evaporating. Several days later, you will discover that some of the water in the tumbler containing the plant has disappeared. Plants give off heat, as well as moisture. Place a handful of dried peas in one of two tumblers. Insert a household thermometer in each tumbler and fill them with sawdust or peat moss. Pour in some water, letting it trickle down the inside wall of each glass. Now place both tumblers in a cardboard box and wrap them with cloth to keep internal heat in and exclude heat from the outside. When the peas begin to sprout, the thermometer in the glass containing them will show a higher temperature than the other.

In these experiments, you have observed many hitherto unsuspected similarities between plants and animals. Not only do plants "perspire," and give off heat as a product of their life processes, but they even suffer distress as a result of over-feeding, just as humans do.

To prove that over-feeding will kill plants, place a sprig of celery in each of two water-filled glasses. To one, add a tiny fragment of a plant-food tablet, and to the other add several whole tablets. Shortly, the celery sprig in the concentrated solution will wither and die, as its moisture flows out to dilute the strong solution in which it is placed. With this moisture lost, the plant is doomed to die.

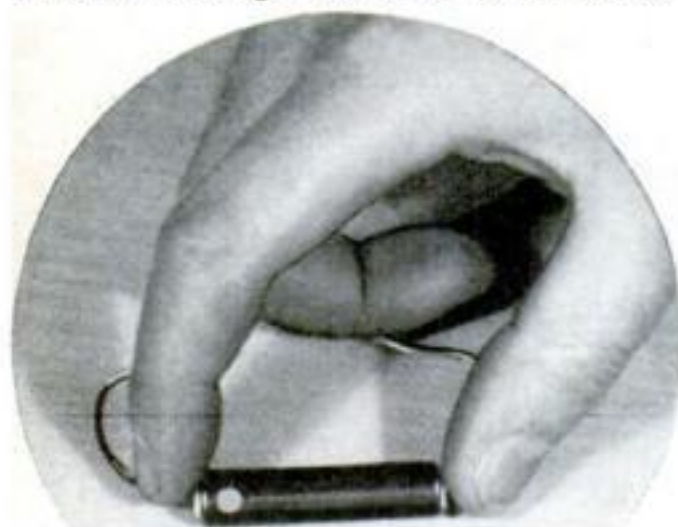
NEW KINKS

Novel Radio Resembles a Camera



A PORTABLE radio now on the market resembles a candid camera in outside appearance and construction. Available with either a shoulder strap or a carrying handle, the four-and-a-half-pound receiver measures four inches in depth, five inches in width, and eight and a quarter inches in length. It utilizes miniature radio tubes recently introduced. Flash-light cells serve as an "A" battery for the set, which boasts of a built-in aerial, dynamic speaker, automatic volume control, superheterodyne circuit, and a headphone plug-in connection for long-distance or one-man listening.

Fine for outings, the radio is available with a shoulder strap or handle

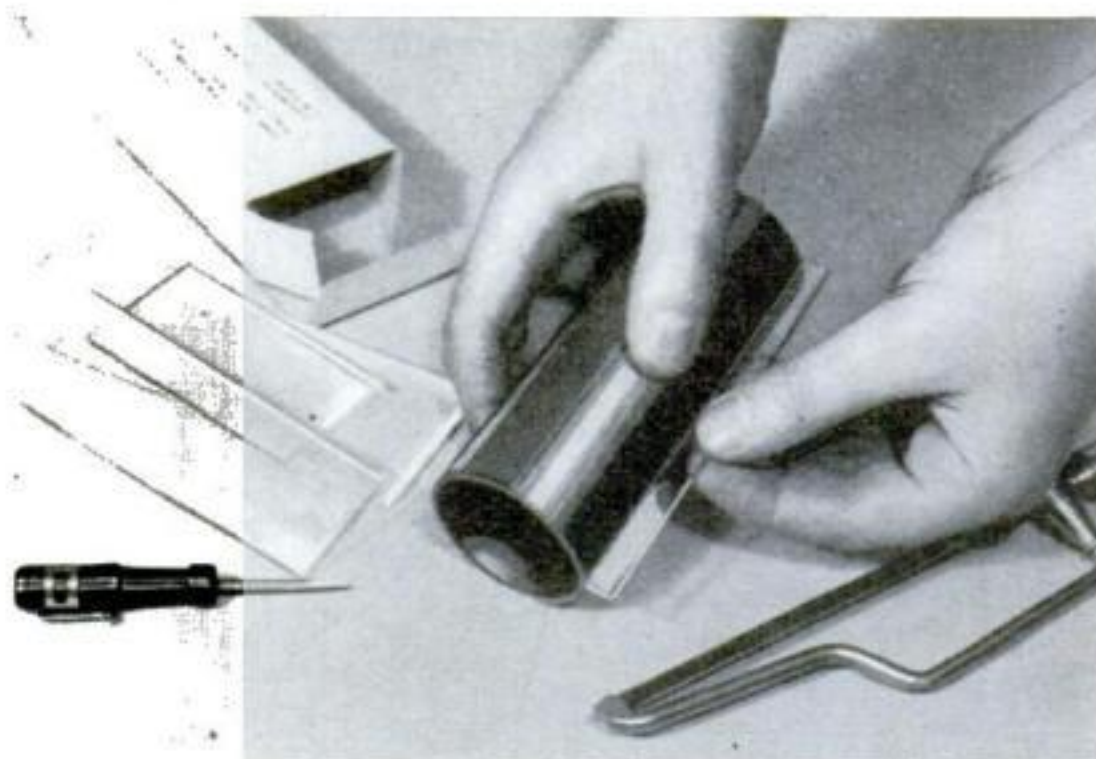


Sheet Plastic for Coil Makers

KITS containing sheets of plastic, like that illustrated below, are now offered to radio amateurs who make their own insulators, coils, and other ultrahigh-frequency equipment. Ribs cut from the plastic can be placed around inexpensive fiber or plastic coil forms to aid in winding transmitter and receiving coils. The ribs are secured to the forms by means of right-angle metal brackets bent slightly to fit the curved surface.

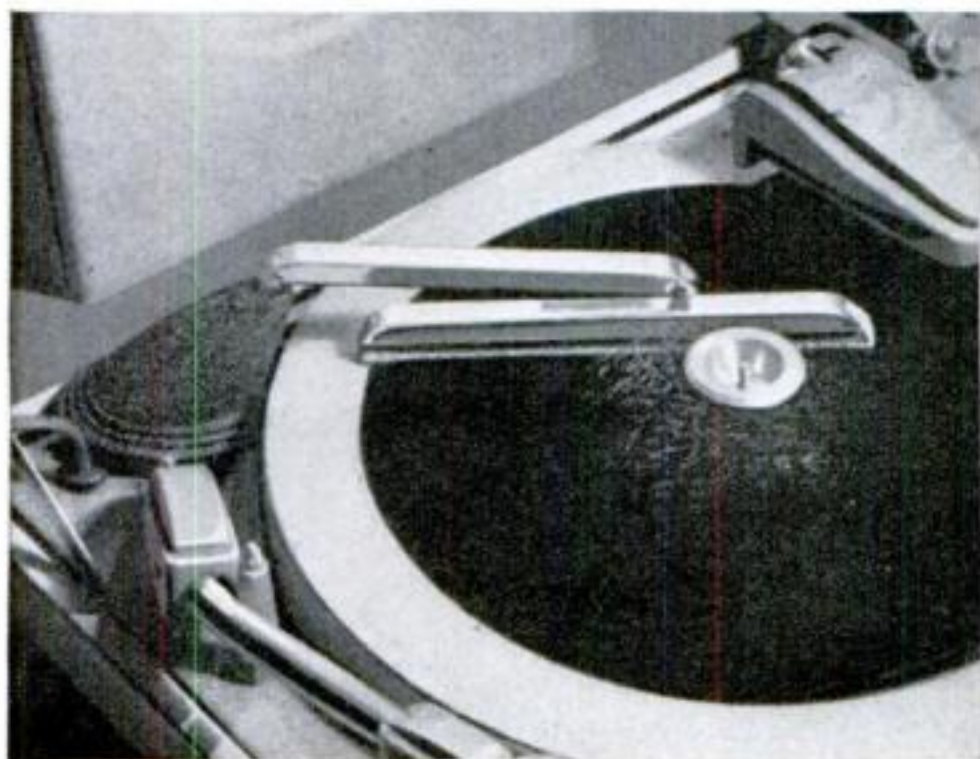
Resistors Warn of Overload

A RED dot at one end of a new resistance unit acts as an overload indicator, turning brown when the resistor is loaded twenty-five percent beyond its rated capacity, and resuming its normal red color when the overload is removed. Noninductive types are available from ten to 10,000 ohms, and others to 70,000 ohms, at five to ten watts.



Fastening a cut-out rib made from the plastic to a coil form

FOR THE RADIO FAN



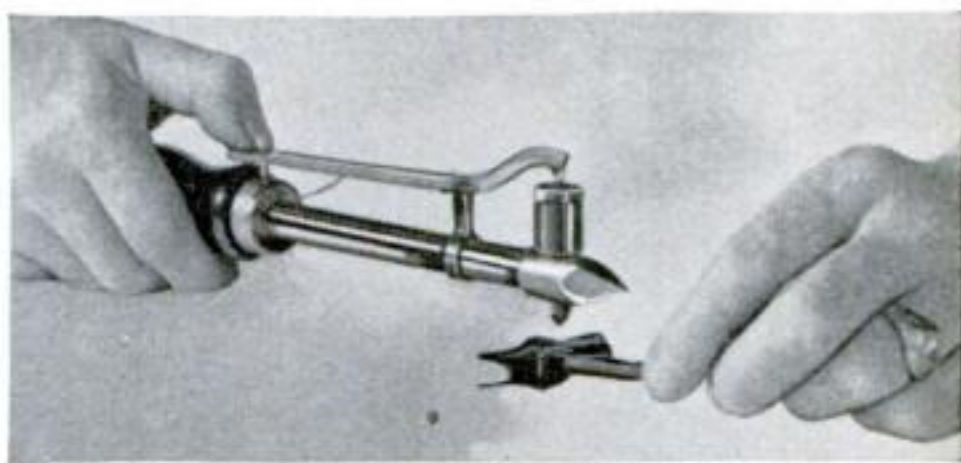
Chips slide harmlessly to the center of the turning record

Wiper Clears Shavings from Home Recorder

WHEN cutting a record on a home recording machine, care must be taken to see that the shavings do not collect around the cutting needle, since they may cause it to jump the groove or lead to excessive surface noise when the record is played back. A new device, designed to brush shavings away from the needle, consists of an aluminum-backed strip of felt which can be adjusted for your turntable, and which is attached to a cast-iron base heavy enough to support the record sweeper without being bolted down.

Iron Applies Solder a Drop at a Time

EASIER, faster soldering is made possible for radio amateurs by an electric push-button iron just introduced. As shown in the photograph at the right, the iron has a device mounted near its tip which releases a drop of solder at the touch of a lever. Thus the heating and application of the solder can be accomplished with one hand, leaving the other hand free to hold the work. The size of the drop of solder can be varied as needed.



When the lever is pressed, hot solder drops on the joint

New Table Radio Can Be Turned on Its Base

MOUNTED on a turntable, a compact radio now available can be turned in any direction for ease and convenience in tuning, for gaining maximum performance from its built-in directional antenna, or for directing the sound from the loudspeaker to any part of the room. Made of a warpless fiber board, the turntable is centered on the bottom of the set so that the receiver is raised a fraction of an inch to allow its feet to swing clear as it turns.



The whole radio can be easily revolved on the built-in turntable



The completed radio, ready to take to vacationland

Midget Portable

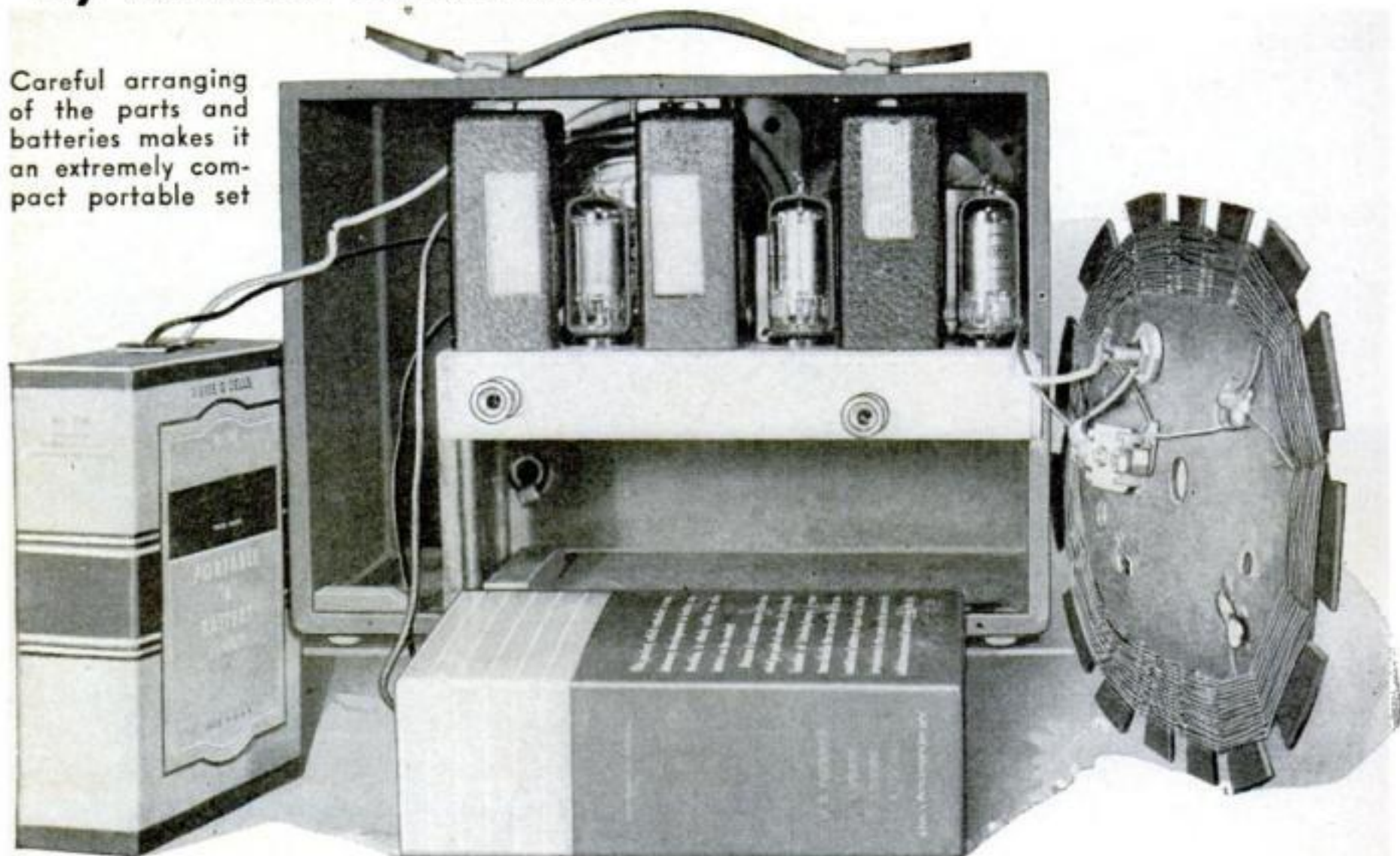
FOR YOUR VACATION

By Howard G. McEntee

FOR SET builders who want a really compact vacation receiver here is the answer. Built around five of the newest midget tubes, the set illustrated requires only two small batteries and weighs only $7\frac{1}{4}$ pounds complete with loudspeaker and built-in antenna. The superheterodyne circuit is particularly powerful and gives exceptional tone and volume.

The $4\frac{3}{4}$ " by $5\frac{7}{8}$ " by $8\frac{1}{4}$ " cabinet was built up of $\frac{3}{16}$ " pressed composition wood, although plywood could be used as well. When the top, bottom, and two end pieces have been cut to size and carefully trued up, each of the four joints should be fastened

Careful arranging of the parts and batteries makes it an extremely compact portable set

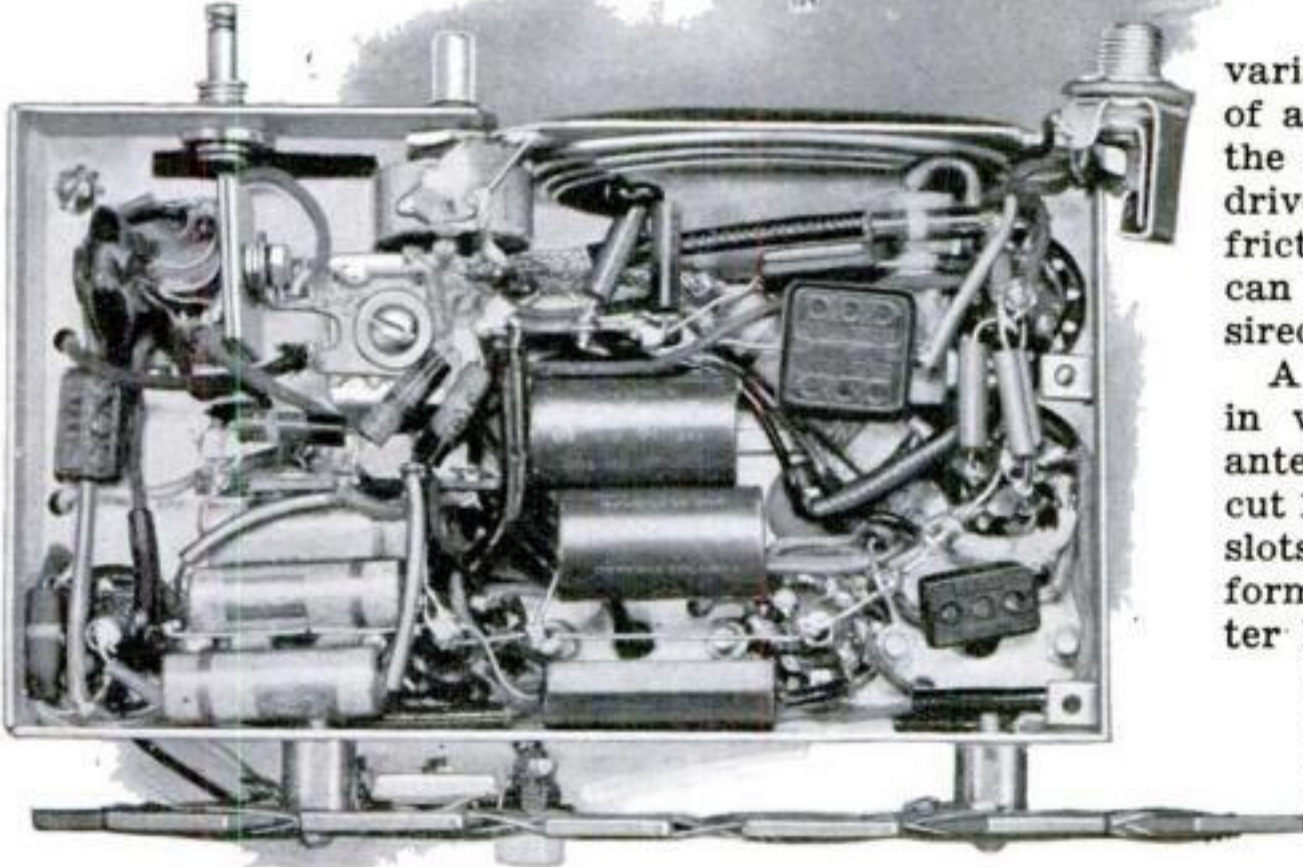
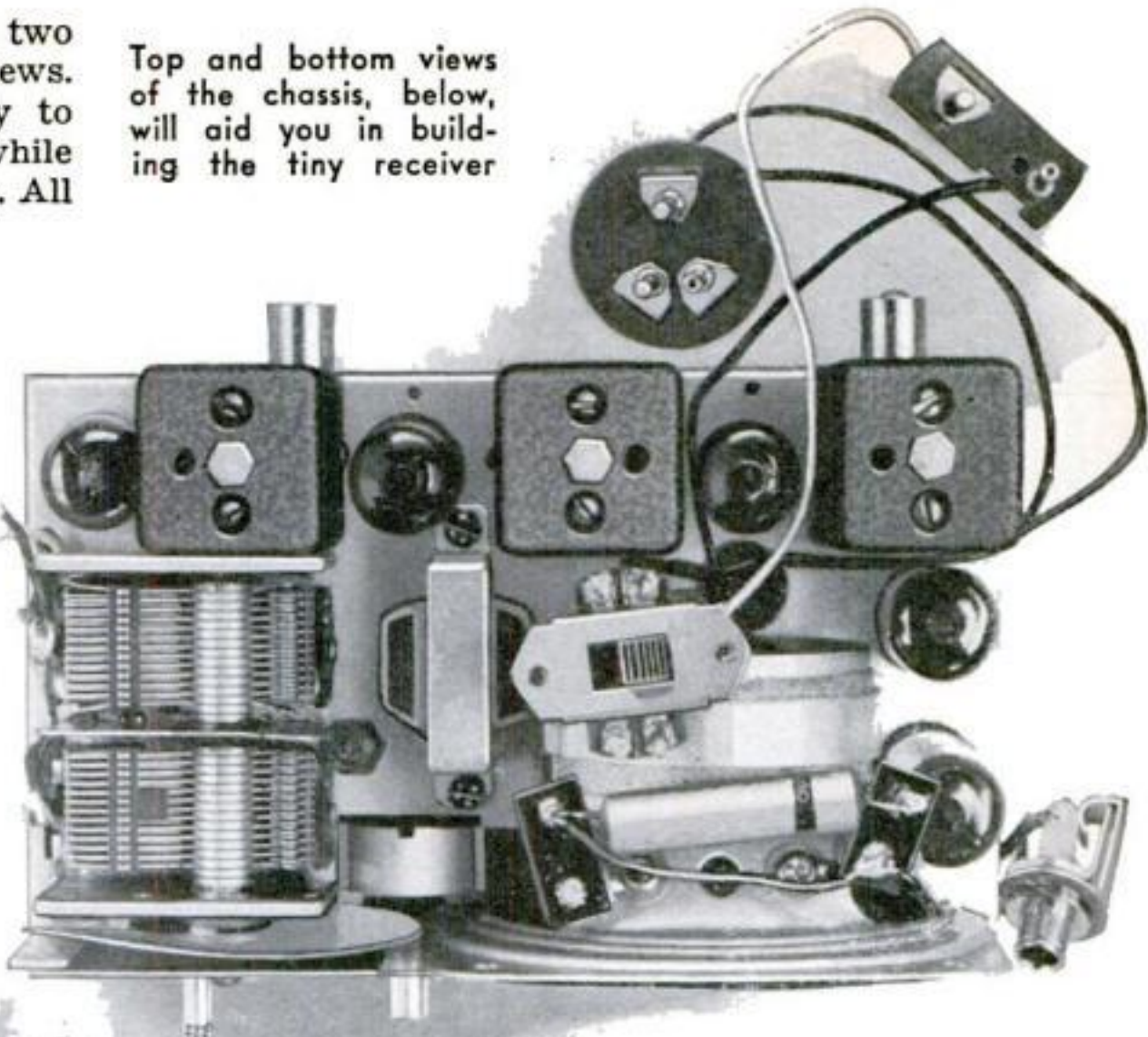


with cellulose cement and two $\frac{1}{4}$ " round-head wood screws. These screws serve mainly to hold the pieces together while the cement dries thoroughly. All holes should be counter-sunk so the screw heads can be covered with wood putty. As a finish the case can be given two coats of clear lacquer with a sanding before and after the first, and a final rubbing down with pumice and rottenstone after the second, followed with wax.

The receiver itself is built on a $\frac{1}{16}$ "-inch aluminum chassis. The various parts should first be spotted in place and the mounting and connection holes drilled.

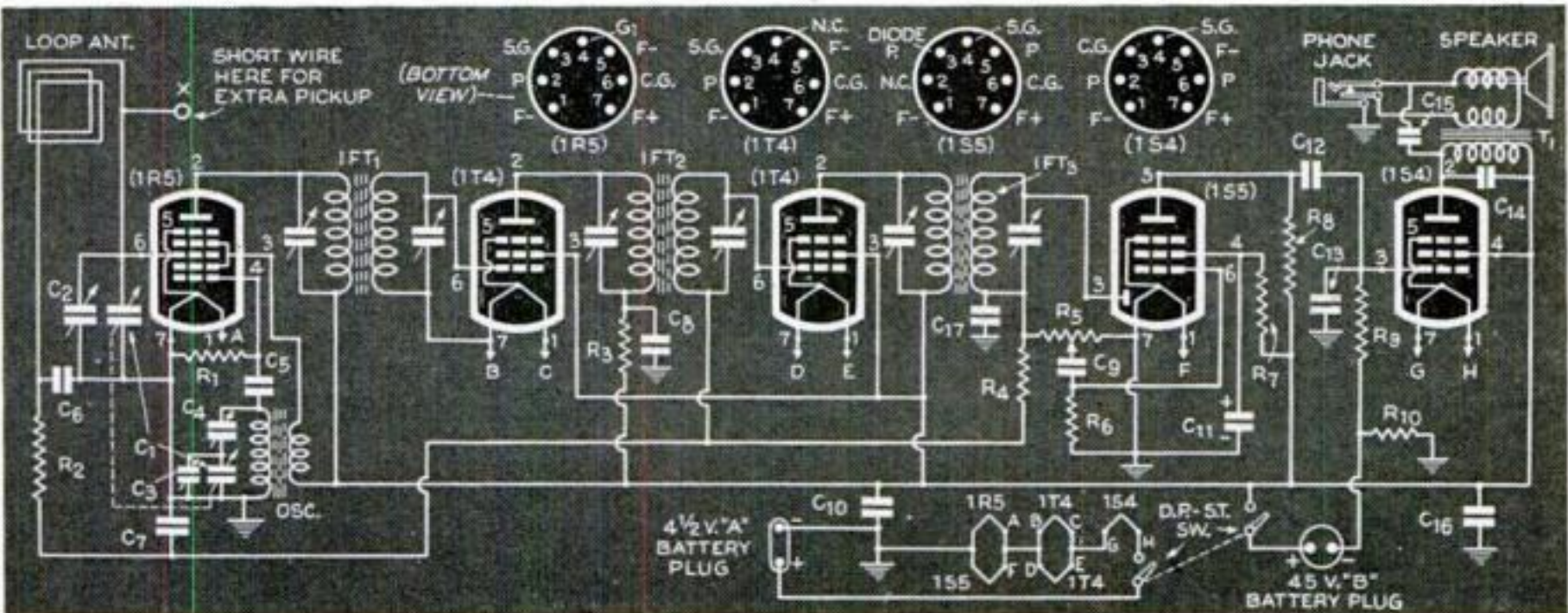
A homemade vernier dial is used to drive the

Top and bottom views of the chassis, below, will aid you in building the tiny receiver

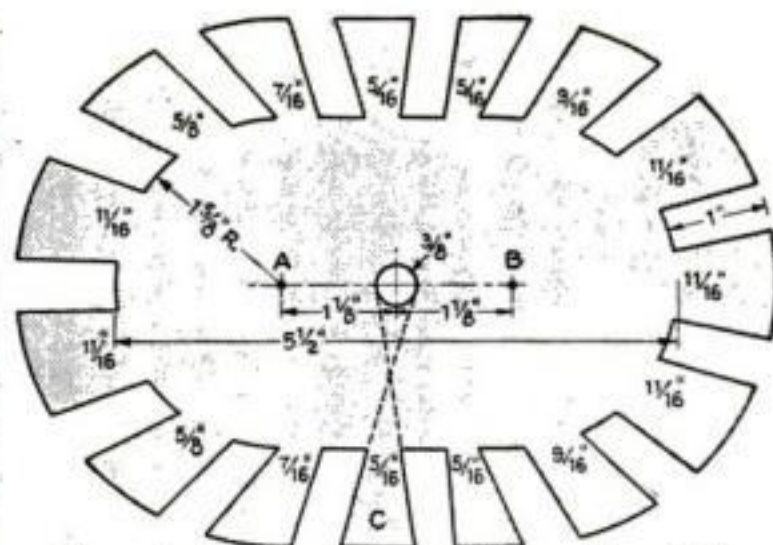
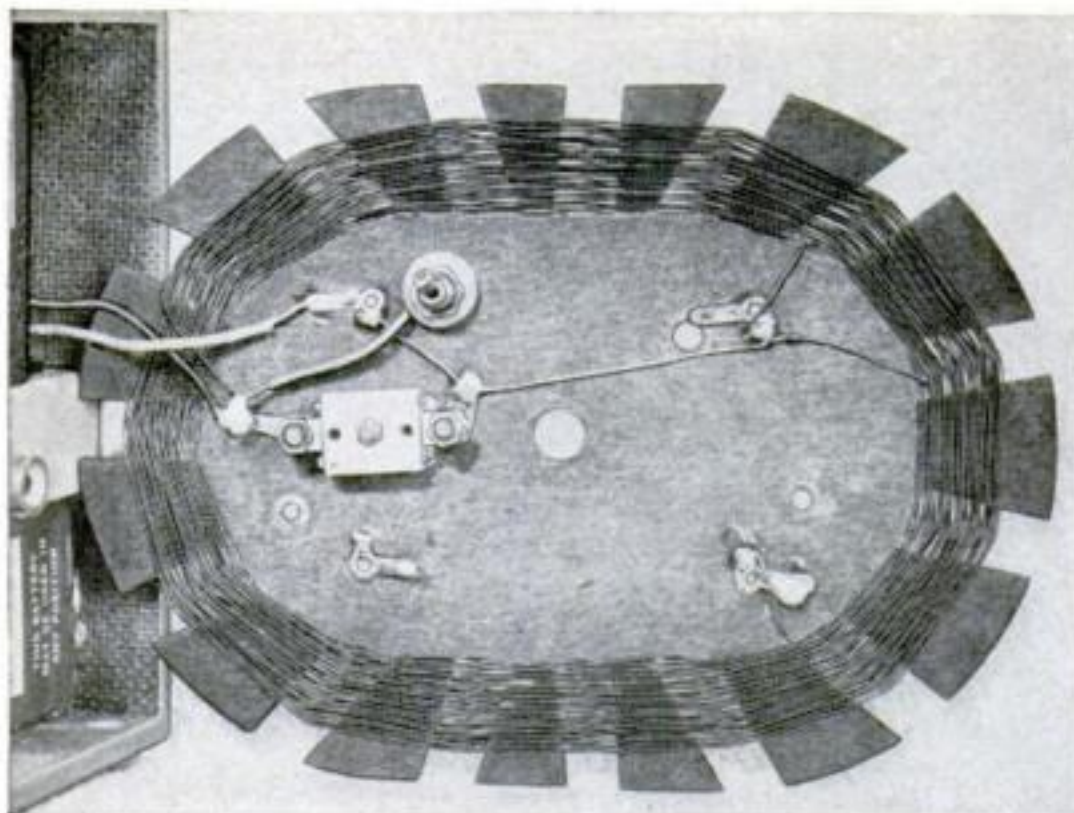


variable condenser. It consists of a celluloid disk fastened to the shaft, and turned by the drive shaft taken from an old friction dial. A regulation dial can be used, of course, if desired.

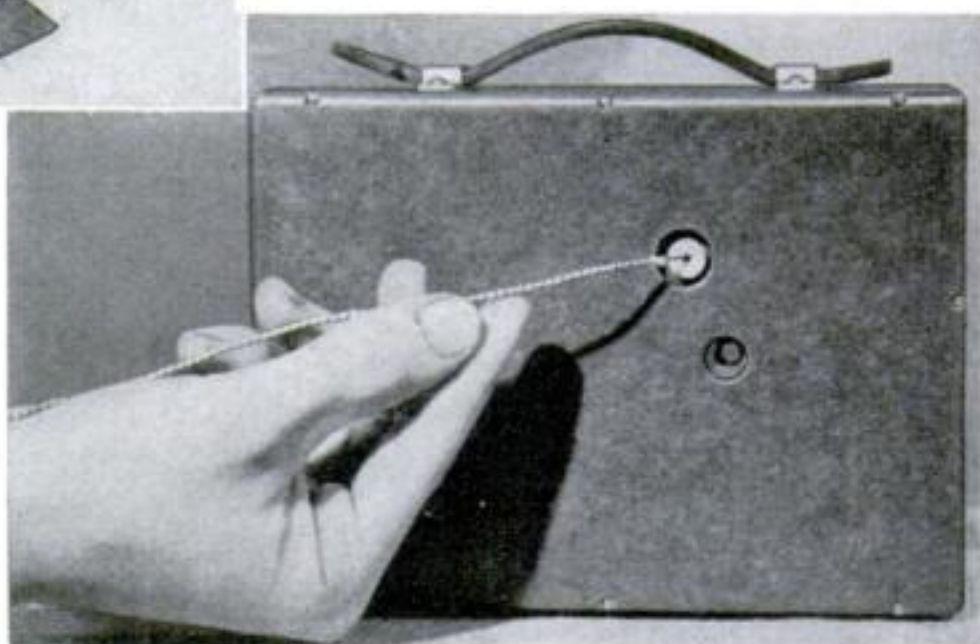
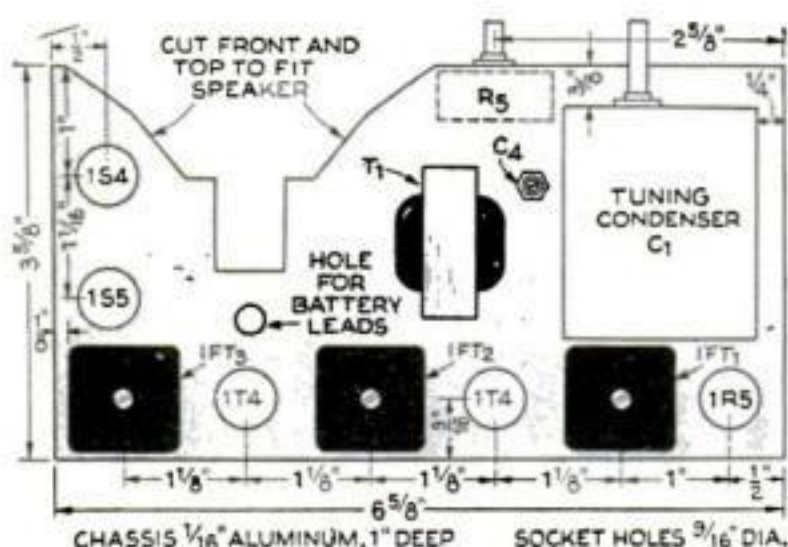
A fiber form should be used in winding the built-in loop antenna. The tabs should be cut 1" deep all around with the slots $\frac{3}{8}$ " wide. In making the form first mark the $5\frac{1}{2}$ " center line. Then with points A and B as centers, draw semicircles with a $1\frac{5}{8}$ " radius joining them top and bottom. Place the $\frac{3}{8}$ "



Follow this wiring diagram carefully. The symbols refer to the text and the parts list on the next page



You should have no trouble making this directional loop antenna. Note the extra connection below for attaching a supplementary antenna when desirable



diameter circle at the center of the oval. The figures on each tab show the widths at the inner ends. Starting at tab C, mark the sides by lines such as those shown dotted. Proceed all around the oval in this manner, then cut out the openings. The loop contains 34 turns of No. 24 D.S.C. wire wound on opposite sides of adjacent slots.

A 30-mmfd. trimmer condenser (C_2) should be fastened to the loop form so that it can be reached through a hole drilled in the back of the case. A terminal for the connection of a short wire for extra pick-up in poor localities also should be provided. The loop should be fastened to the rear of the chassis with two screws.

An on-off switch is provided at the top of the case under the handle. For reception of weak signals, or in locations where quiet must prevail, headphones are required. A jack on the front panel is included.

When the set is in use, the loop antenna will be found highly directional, minimum signal pick-up occurring when the plane of the loop is at right angles to the station being received. This minimum, or "null point," can be used for approximate direction finding in the woods or on a boat.

LIST OF PARTS

Condensers: C_1 .—Two-gang variable, 350 mmfd. each section.

C_2 .—Trimmer, 3-30 mmfd.

C_3 .—(On C_1).

C_4 .—Padder, 500 mmfd.

C_5 , C_{17} .—Mica midget, 50 mmfd.

C_6 , C_7 , C_8 , C_9 , C_{12} .—Paper, .01 mfd., 400 volt.

C_{10} .—Paper, domino type, 25 mfd., 200 volt.

C_{11} , C_{16} .—Midget electrolytic, 10 mfd., 50 volt.

C_{13} .—Mica midget, 100 mmfd.

C_{14} .—Mica midget, .004 mfd.

C_{15} .—Paper, .05 mfd.

Resistors: R_1 .—100,000 ohm, $\frac{1}{2}$ watt.

R_2 .—.25 meg., $\frac{1}{2}$ watt.

R_3 .—20,000 ohm, $\frac{1}{2}$ watt.

R_4 .—2 meg., $\frac{1}{2}$ watt.

R_5 .—Variable, .5 meg.

R_6 .—10 meg., $\frac{1}{2}$ watt.

R_7 .—3 meg., $\frac{1}{2}$ watt.

R_8 .—1 meg., $\frac{1}{2}$ watt.

R_9 .—.5 meg., $\frac{1}{2}$ watt.

R_{10} .—200 ohm, $\frac{1}{2}$ watt.

Transformers: T_1 .—Midget, output, 8,000 to 3 ohm.

IFT₁.—Iron-core, input, intermediate frequency.

IFT₂.—Iron-core, interstage, intermediate frequency.

IFT₃.—Iron-core, output, intermediate frequency.

Miscellaneous: Batteries, 3-inch permanent-magnet speaker, five tubes sockets, $\frac{1}{4}$ pound No. 24 D.S.C. wire for loop, case, etc.



ONE CONTROL

operates this beginner's

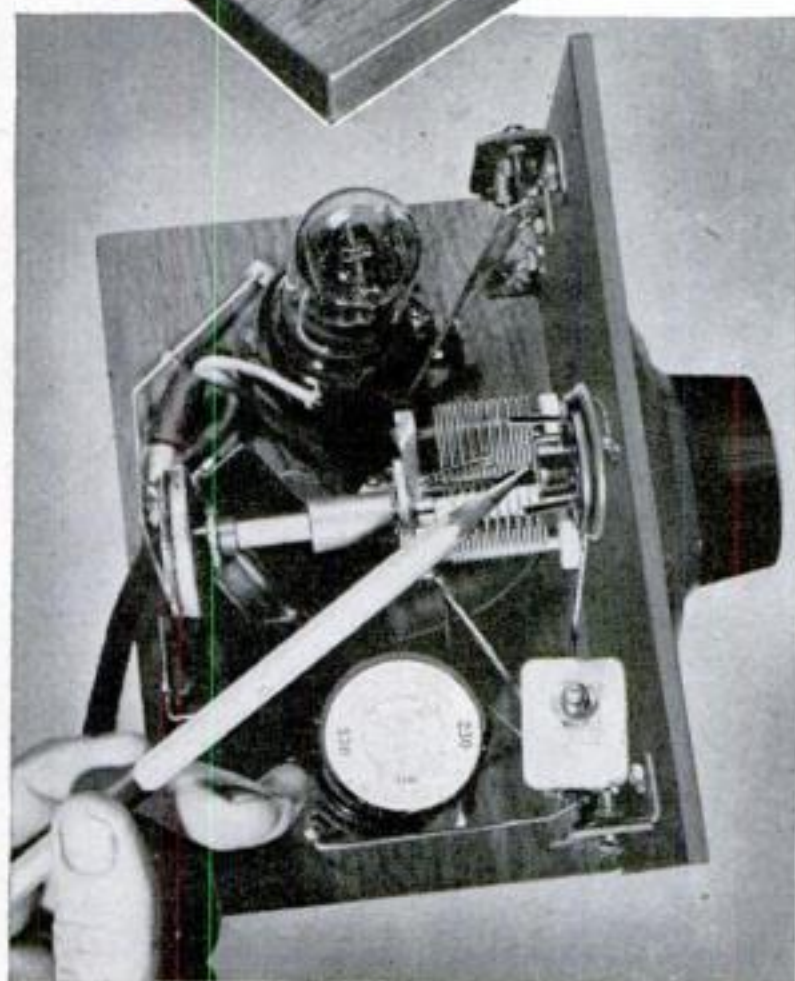
RADIO

A SINGLE dial operates this novel one-tube battery radio; turning the set on when it is rotated to tune in stations and turning it off when moved to its minimum setting. This automatic switching is accomplished by coupling the condenser shaft to an inexpensive rheostat which has been altered by flowing solder over the winding as shown in the sketch.

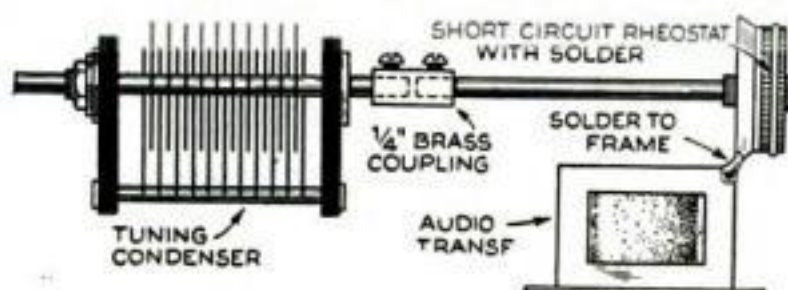
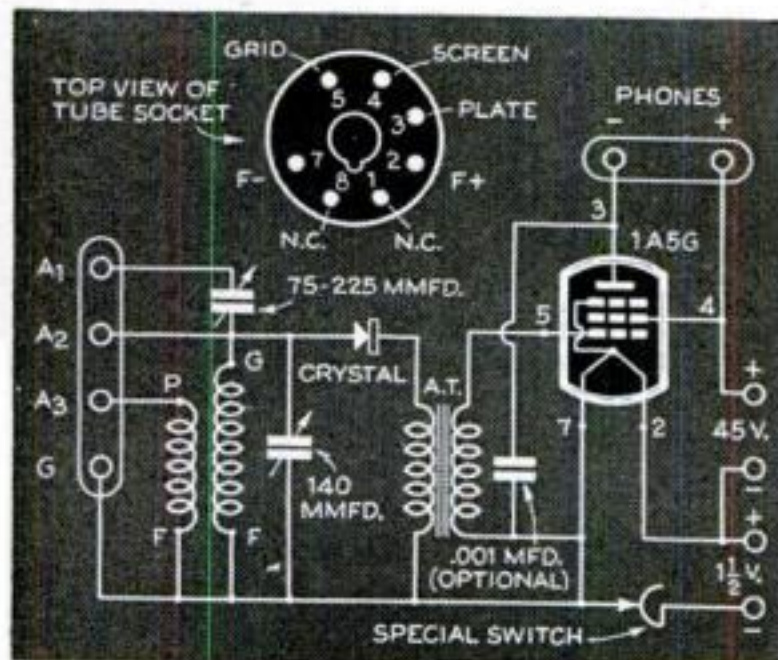
Follow this rear view of the set when placing the parts. Below, the crystal detector with cap removed

The circuit is easily wired.

A crystal detector is followed by a single stage of audio amplification. One 45-volt "B" battery provides the plate voltage and a single 1.5 volt dry cell serves the filament. Of the three antenna connections, Terminal A₃ is the most selective, while A₂ provides the greatest volume. Terminal A₁ connects a trimmer condenser into the lead for a short antenna.



The single knob that controls the receiver

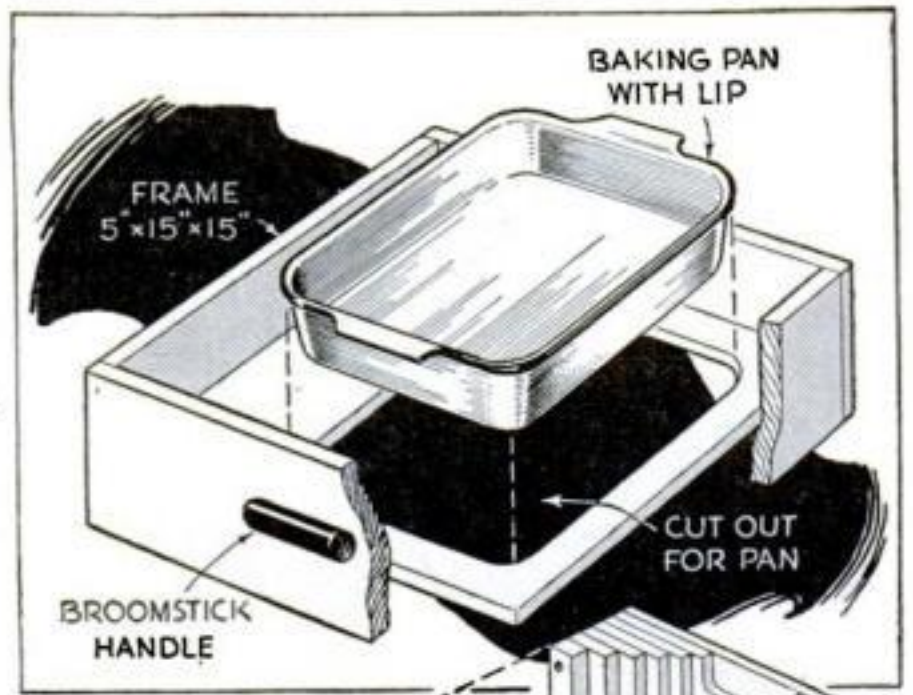


How the automatic switch is fashioned from a rheostat

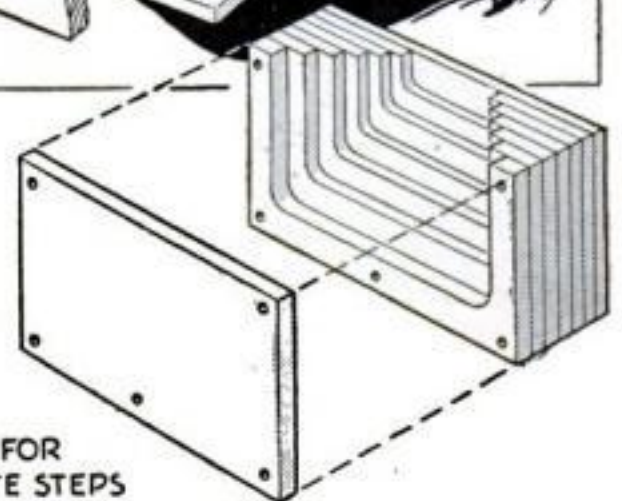
Pet Turtles Thrive in Land-and-Water Home



BOYS who own small turtles will find it more amusing to watch their pets if they are kept in the type of aquarium illustrated. The frame and bottom are $\frac{1}{4}$ " or thicker plywood. The bottom is cut out to fit a large baking pan and is nailed in the frame so that the pan is about $\frac{1}{2}$ " off the floor. To enable the turtles to crawl in or out of



How the pan fits into the frame and, at right, a mold for the steps



the pan, steps are made from a mixture of one part Portland cement, one part fine sand, and water. This is poured into a mold made by jig-sawing $\frac{1}{4}$ " boards as shown and nailing them together with two side boards. A small cardboard Christmas-tree house, with the doorway enlarged and the floor cut away, forms a resting place for the turtles.

The inside of the box is enameled or painted light green; the outside, ivory. Let the finish dry thoroughly for at least several days.—ANTHONY WALLACE.



FINISHING PECKY CYPRESS

[PAINTING]

Cypress of the type known as "pecky" is a very durable and inexpensive wood for outside work such as pergolas, trellises, and garden furniture. It can be given an attractive gray-green finish as follows:

1. Make up standard house paint of the color desired, then thin with an equal amount of boiled linseed oil.
2. Sand all portions to be stained with at least No. $\frac{1}{2}$ garnet paper until reasonably smooth.
3. Brush on a coat of color and let set from fifteen to thirty minutes, depending on weather conditions.
4. Wipe crosswise with clean burlap. Even up the color effects or high-light as desired with rags. Step back about fifty feet once in a while to check up on the color effect.

The soft portions of the grain will absorb the color first, and the final wiping should expose the hard grain to produce a two-toned effect. More than one color can be applied if a day or two is allowed between applications, and this treatment gives a multicolor effect of real beauty if the choice of colors is harmonious.

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BY THE MAKERS OF MOBIL OIL



THERE are two modern ways to reduce the cost of shopmade floor-type machine tools: Substitute concrete for the lower section of the base, and use as much welded steel construction as possible for the upper section.

To give the edges of metal-cutting tools that new superfinish which is superseding oil-stoning, use a silicon-carbide wheel of medium grade and about 250 grain, and cut the conventional surface speed in half.

The general recommendations for drilling stainless steel are: A high-speed steel drill as short as the job will allow, 25 percent more lip clearance, and approximately 40 percent less speed than required for mild steel. And don't fail to check the condition of the spindle.

When using a small hand grinder to retouch a soft die or the like, all excess stock should first be removed with a related rotary file. Small rotary files and abrasive points are intended to work together.

A drill-press operation, and perhaps the making of a drill jig as well, can sometimes be eliminated on short-run work by doing a cross-drilling job in the lathe with an electric drill.

To square up or file a perfectly straight edge on a piece of sheet stock, clamp the part to a hardened steel parallel, which will act as a guide.

The fact that you are the best machinist on the floor does not necessarily put you in line for the foreman's job. You must have good original ideas of your own and know enough about managing a shop to put them to work to the best advantage.

Even if only for experimental purposes, an extra motor with a reversing switch can often be rigged up to operate a machine carriage and do away with the more costly use of bevel gears, springs, and whatnots.

Machinists take pride in owning high-grade micrometers, and it is essential to have them. Nevertheless, for repeated comparatively rough measurements on certain types of work, it would be good horse sense to save wear on a very expensive "mike" and use one of moderate cost.



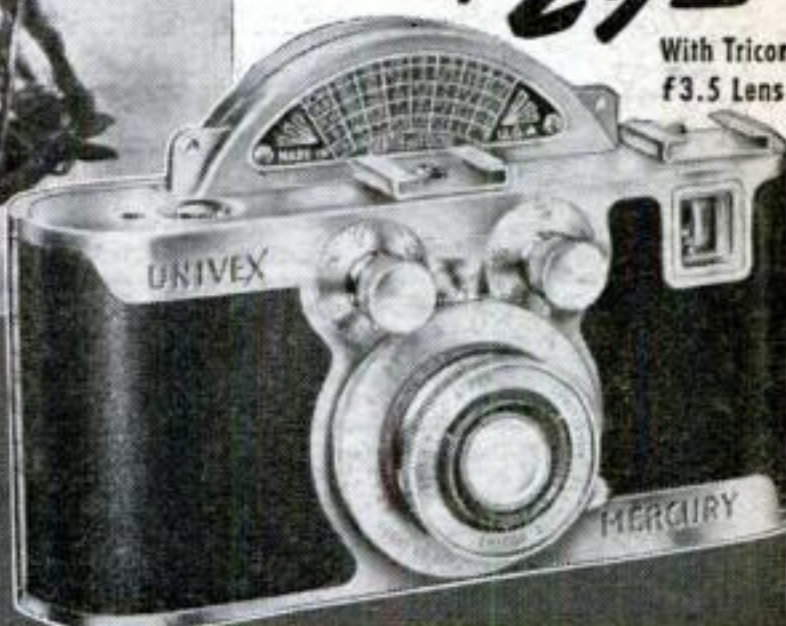
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The materials are: One garden hose coupling, one union, a 5½" nipple, a 90-deg. elbow, a close nipple, a 3" nipple, a 21" pipe, a 1" tee, two wall-bibb faucets, a key that operates them both, a spray head, and a tin can, box, or other receptacle suitable for a concrete mold. The pipe and fittings were all 1", but since an ordinary garden hose is only ⅝", it is believed that a smaller size of pipe would serve just as well.

Join the hose coupling to the 5½" nipple with the union. Put the elbow on, and to this add the 21" pipe. Next screw on the tee, to which connect one of the wall-bibb faucets with the close nipple, and affix to this faucet the spray head. Then add the 3" nipple to the tee, and add the remaining wall-bibb faucet. Punch a hole in the side of the mold and shove the horizontal section of the pipe through it. Brace the vertical section upright. Fill the mold with concrete mixed in the proportion of one part Portland cement to three parts of washed sand. Use the least amount of water possible and let it harden overnight.—H. S. McC.



The mold used in casting the base of this sprinkler was a can 7" high, 9" in diameter

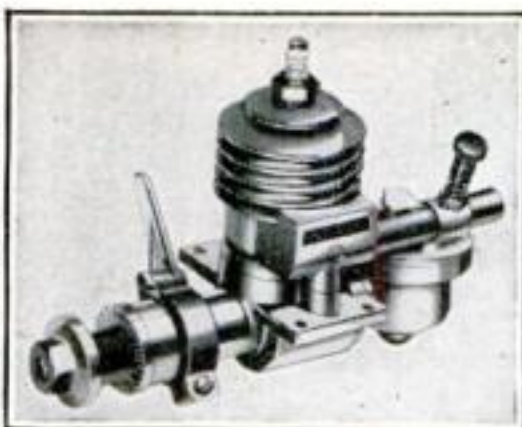
Photo Developer Removes Paint

FLAT paint can be removed from small objects quickly and easily by using ordinary M. Q. photographic developer. If an even stronger remover is desired, mix less water with the powder than is called for in preparing a developing solution. This is cheaper to use than high-grade commercial paint removers.—S. FENSTER.

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(Continued on page 205)

Our Workshop Plans

(Continued from page 204)

RADIO

All-Wave Portable Receiver, 2 tubes, battery operated, 217-R50
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Ship Models

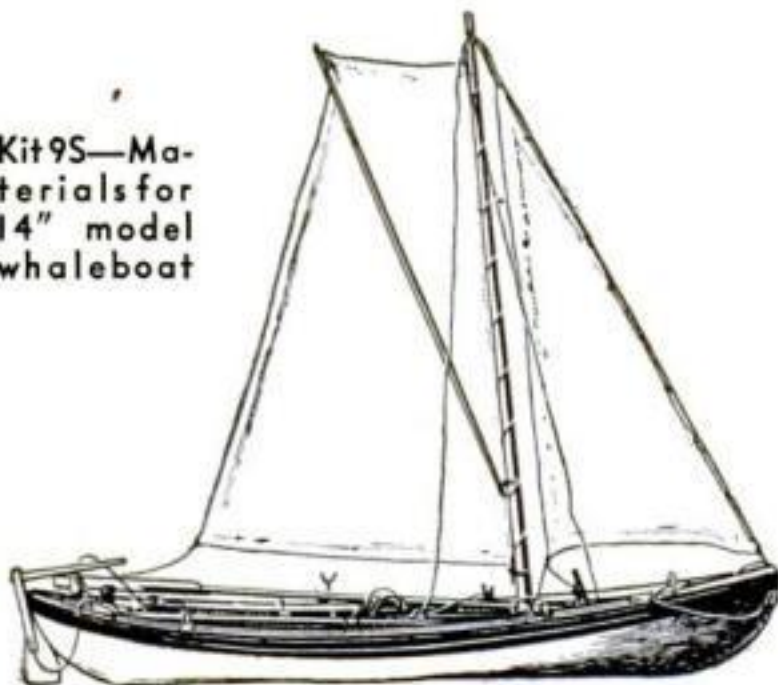
ARE EASY TO CONSTRUCT WITH OUR CRAFTWORK KITS

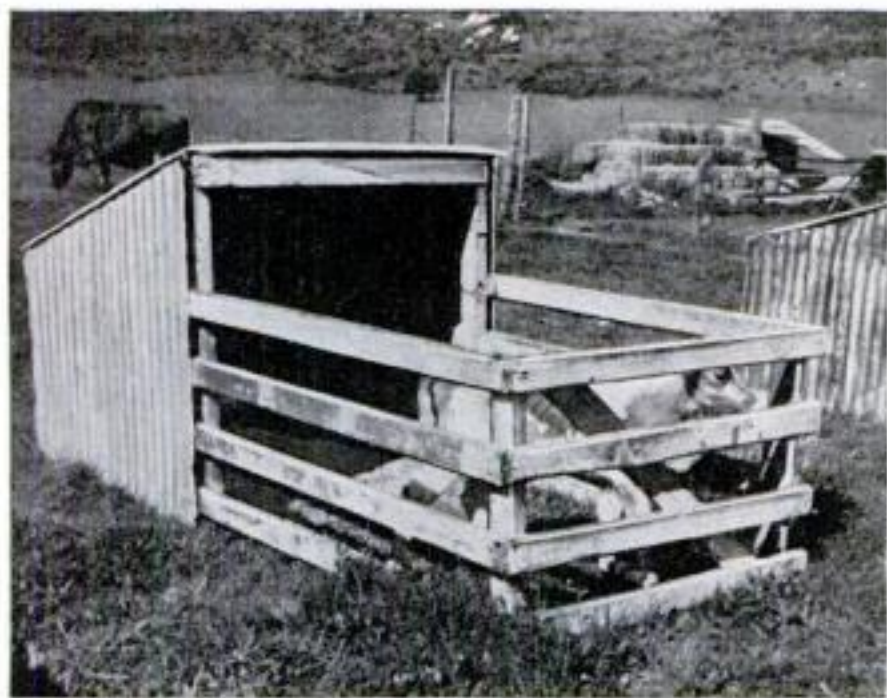
YOU don't need to be an expert craftsman to build a ship model. Our construction kits are designed to simplify everything for you. A certain amount of preliminary shaping has been done on most of the hulls or hull lifts, and the other materials are of such sizes and shapes as to make it easiest for you to transform them into their final form. Full-size blueprints, as well as instructions, accompany each kit.

For the summer we suggest a project such as the 14" model of a whaleboat and its equipment. The kit can be seen in the photograph at the top of this column; the completed boat is shown at the bottom. It costs \$2.75 (25 cents additional west of the Mississippi River and in Canada).

An illustrated price list of all our construction kits will be sent free upon receipt of a self-addressed, stamped envelope. Address POPULAR SCIENCE MONTHLY, Dept. 80A, 353 Fourth Avenue, New York.

Kit 9S—Materials for 14" model whaleboat





Movable Shelters Keep Calves Healthy

BY PROVIDING each calf with a home of its own, a Lakeside, Calif., dairyman has been able to solve most of his calf troubles. When one day old, the calf is taken from the cow and installed in a neat little pen with a shelter at one end in which it sleeps. The calf learns to eat without being worried by stronger or older stock, is easily cared for if sick, and is safer from contagion, in case disease develops in the herd. It is also a great advantage to be able to move the pen frequently to a new location so that the calf can have clean ground and fresh green feed at all times. Two men can carry the pen.

Any available material may be used. The shelter illustrated is covered with second-hand corrugated iron sheets, but thin outdoor plywood, hard composition board, or thin insulating board would be better. These should all be well painted.

If insulating board is used, the roof must be waterproofed. This can be done inexpensively with asphalt emulsion. The surface of the insulating board must first be uniformly wet. A coat of the emulsion, well thinned with water, is applied and allowed to set; then a final thick coat is brushed or sprayed on.

In localities where there is considerable rain, it would pay to add a wooden floor in the shelter part of the pen to keep the calf off the ground.—W. W. WHEATLY.

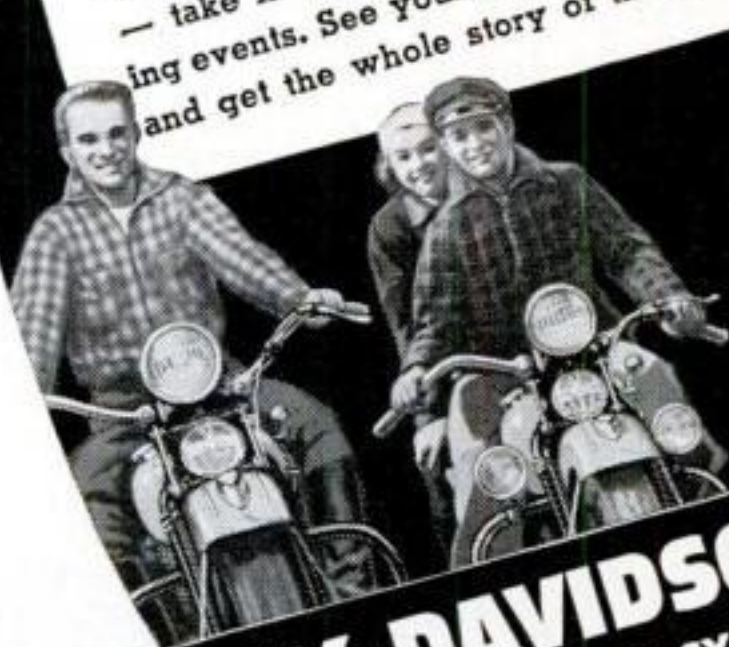
Fitting Grips to Handlebars

THE rubber grips on bicycle handlebars often become loose. Usually an application of shellac will make them stick, but if they fit too loosely, wrap a layer of friction tape spirally around the ends of the handlebar, apply shellac, and force the grips over the tape.—HARRY FLEMING.



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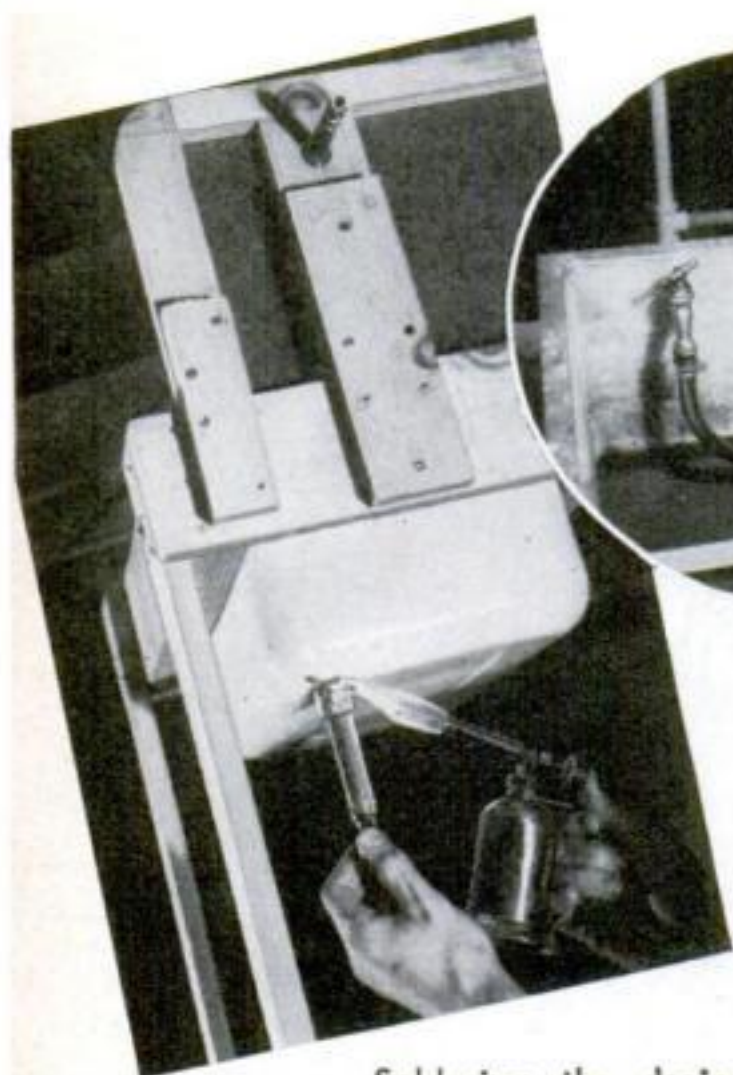
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Portable Darkroom Sink

SUPPLIES RUNNING WATER



Soldering the drain. In circle, rubber hose supplies water from cellar

By **FRANK McCARTY**



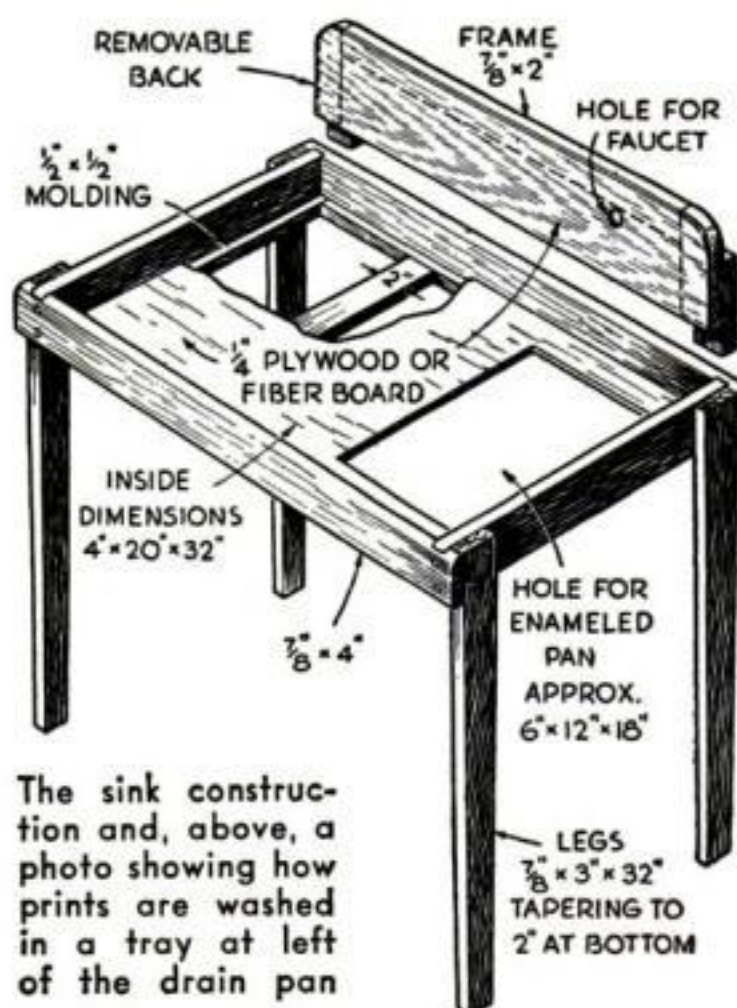
RUNNING water in the darkroom can be enjoyed with little expense or labor by building a portable sink like the one illustrated.

A rectangular form is made from common white pine, $\frac{7}{8}$ " thick, the corners being held with casein glue and wood screws. Strips of $\frac{1}{2}$ " square pine are fastened around the bottom of the form, and two cross braces are placed in between to support the bottom, which may be either $\frac{1}{4}$ " plywood or $\frac{1}{8}$ " tempered fiber board. Be liberal with the glue and make sure all joints are tight.

Legs are attached to each corner with wood screws. Build up the back of the sink by using 2" strips of pine, and cover it with either plywood or fiber board. Wooden cleats are used to fasten the back to the sink.

The lower part of the sink is a large enamel pan about 6" by 12" by 18", which can be obtained for about a dollar. Cut a hole, slightly smaller than the pan but the same shape, in one end of the bottom of the wooden sink. The pan is placed under this hole and held with wood cleats under the rim.

Drill a hole in the lowest corner of the pan and enlarge it with a half-round file until a short length of $\frac{1}{2}$ " brass or copper pipe can be inserted. File off about $\frac{1}{16}$ " of the enamel ([Continued on page 210](#))



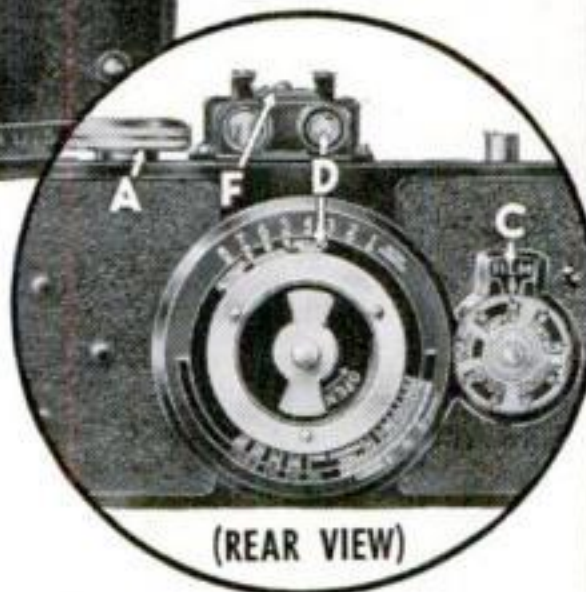
The sink construction and, above, a photo showing how prints are washed in a tray at left of the drain pan



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606-7K

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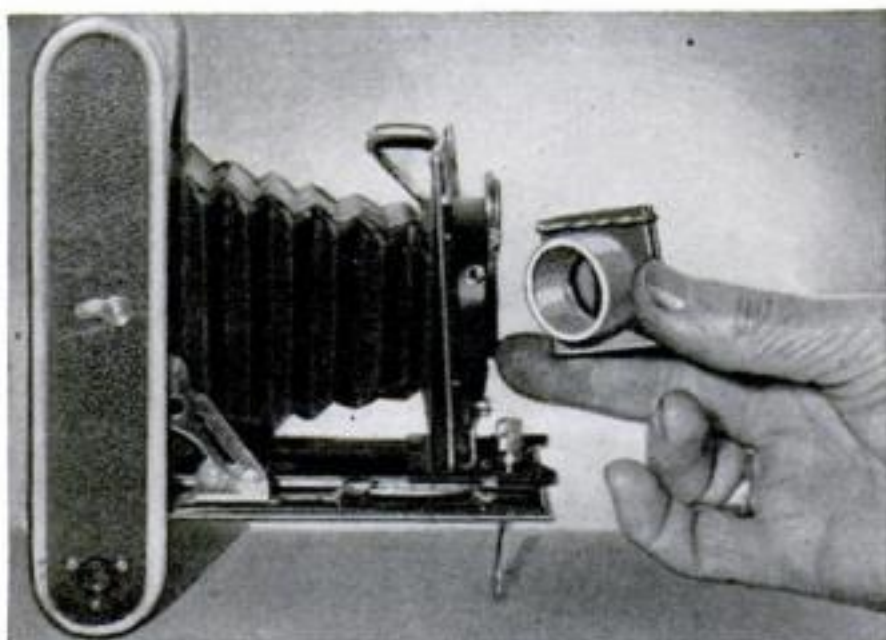
(Continued from page 208)

around the hole on the bottom of the pan. The exposed metal can then be tinned with solder, and the pipe soldered in for a drain. A standard faucet, obtained secondhand, is placed in a hole in the backboard.

Water is supplied through a garden hose connected to any convenient faucet. Screw-on clamps are used on both ends to insure tight connections. A length of hose is also used for a drain, and it can empty into the cellar sink or other outlet.

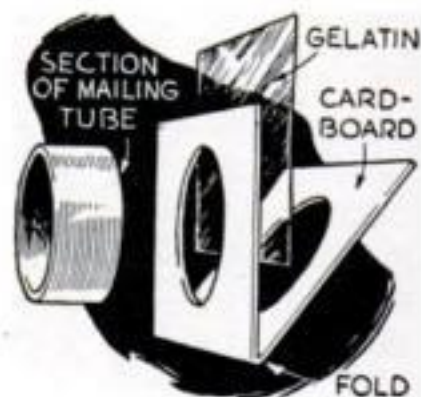
All the wood is finished with spar varnish. The inside of the wooden sink is painted with rubber tire paint, either black or white, to make it absolutely waterproof.

If and when the necessity arises, the back, legs, and hose connections can be removed and placed inside the sink for moving.



Gelatin Filters Mounted in Cardboard Holder

GELATIN filter stock in a variety of colors can be purchased in small square sheets from any well-stocked photo-supply house and cut to fit a homemade holder of the type illustrated. Heavy but flexible cardboard is used for making the holder, which is glued to a short section of heavy mailing tube of a size to fit snugly over the lens barrel. It is an improvement to line the tube with black plush. In use, the holder is opened, the required gelatin filter slipped between the halves, and then the halves are held together with a rubber band.—L. B. ROBBINS.



The holder is glued to a tube, which fits over the lens barrel

Wizards of Fire!

(Continued from page 64)

out in a line 1,000 feet long, they begin firing their guns, and airplanes of whirling fireworks rise from the decks of carriers and battleships.

To wipe out memories of the fleet, and prepare for the grand finale, a great Niagara Falls next splashes "water" of dazzling white magnesium and aluminum fire from a cable sixty feet in the air and 1,000 feet long. Finally comes the slam-bang wind-up of giant fancy bombshells, ending with shells of great brilliance and deafening noise.

Behind the producers of fireworks shows are the crews of specialists and the strange factories that make the fireworks. Most of the hazards connected with the business still remain with the workers who compound the pyrotechnic pieces, rather than with the men who shoot them. For this reason, fireworks plants are generally isolated, and the loading is done in scores, or even hundreds, of widely separated buildings, each occupied by only one or two workers.

To prevent an accidental spark, mixing and loading tools are specially made of wood and brass, or other non-sparking materials. Daylight alone is used for illumination, even electric light being considered too much of a risk. Each worker takes only a half hour's supply of explosives into his building at one time, and for fear of carrying chemicals on his clothing or shoes he is forbidden to enter any other building where a different type of mixing or loading is going on. Even a high wind blowing the length of the plant will cause a shutdown, owing to the fear of fire and the blowing about of chemicals.

Besides creating the elaborate units for the professional showman, these factories make the tens of thousands of smaller pin wheels, skyrockets, salutes, Roman candles, and other novelties that are sold all over the country for Fourth of July, Christmas, and other fête days. Ranging from tiny pin wheels that retail at two for a nickel, to private display outfits that run up to nearly \$1,000, these "commercials," as they are called, make up the staple line of the manufacturer. Although small "firecrackers" are still made in China, everything larger than these is made in American plants, to the tune of about \$4,000,000 worth a year.

Whether you set off your own fireworks, this Fourth of July, or enjoy as a spectator an elaborate display staged by pyrotechnic artists, you will be entertained by the handiwork of the wizards of fire.

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You see what you get before snapping the picture.



Left: Full-Size Image in Ground-Glass Finder.

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Flying Flivvers

(Continued from page 50)

is their unspectacular record of everyday, commonplace, amateur flying.

Last summer, for example, N. O. Brantley and his wife climbed into their Cub monoplane at Mt. Holly, N. J., and with their pet black-and-white spaniel, Teddy, curled up on light camping equipment in the luggage compartment, took off for a two-weeks vacation. Near the White Mountains in New Hampshire, they sighted a small, unused airport surrounded by woods. Landing, they set up their tent in a grove, camped out for two weeks, then flew back to Mt. Holly. The total cost for transportation was ten dollars.

Recently, the designer of the Taylorcraft flivver plane, C. Gilbert Taylor, made a quick business trip from his plant at Alliance, Ohio, to New York City, approximately 400 miles away. His fuel bill was \$2.90. A year and a half ago, when Johnny Jones hopped non-stop from coast to coast in his Aeronca, he covered the 2,785 miles at a cost of \$25.70 and averaged twenty-two miles on a gallon of gasoline. An amateur who took "flyaway delivery" on a Cub recently, carried a passenger 2,400 miles from Pennsylvania to California. The average cost for each person was half a cent a mile.

With such economy of operation, it is not surprising that the modern light plane is rapidly becoming a machine-of-all-work. In Quincy, Ill., a flying baker loads his flivver plane with pastries and makes quick deliveries in neighboring communities. In Vancouver, Wash., the owner of a golf course hops off occasionally to check up on business from the air. At Salem, Ore., Lee Eyerly jumps in his plane and flies home for lunch every noon. He makes the six miles in half the time it would take by car.

Monty Stahlman, a sawmill owner in Pennsylvania, has found he can save time in locating likely tracts of timber by using a flivver plane. He sits down in the nearest pasture or cornfield to dicker with the owner. In Alaska, the owner of 70,000 reindeer is riding herd on his animals with the aid of a light plane and, in Texas, a cattleman inspects his 120 miles of fences from the cabin of a low-flying Cub coupe.

Working out of Gooding, Idaho, another light-plane owner, Lemoin Stevens, has developed a unique flying service of his own. He rents himself out at so much a day to ranchers and sheepmen as an aerial coyote killer. Cruising over the countryside in his flivver plane, Stevens waits until he sights one of the predators slinking along below. Then, diving like an eagle, he swoops close

to the fleeing coyote. When only thirty or forty feet above it, he blazes away through the window with a sawed-off shotgun.

In recent months, the light-plane industry has received a tremendous boost from the program of the Civil Aeronautics Authority in which thousands of students are being trained as civilian pilots in 300 colleges and universities. Air instruction is given almost exclusively in light planes. In addition to their low initial and operating expense, such machines provide the beginner with an extra margin of safety. When stalled, they drop into a shallow dive instead of the long, steep plunge of a heavier plane. In emergencies, they can sit down in tiny fields where bigger, faster ships would crash. A forty-horsepower Cub trainer, for instance, will land at thirty miles an hour and run hardly more than 100 feet. It will take off in 150 feet and climb 400 feet in sixty seconds with a useful load of 500 pounds.

Up until recently, the student who could not afford to buy a plane of his own when he got a pilot's license, had little chance to enjoy the fun of private flying. The cost of renting a ship—twenty dollars an hour—was prohibitive.

Today, you can rent a monoplane for less than a third the former figure. At the same time, the cost of instruction has dropped and easy-term payments enable enthusiasts, even in modest circumstances, to own ships of their own. On one recent day, more than twenty amateur pilots took wing from Lock Haven, ferrying home newly purchased planes. The light plane is realizing a goal of decades. It is providing wings for Everyman.

POPULAR SCIENCE Question Bee

THESE are the correct answers to the Question Bee on page 116. Give yourself five points for each one you had right. A total score of 75 to 85 is good; 90 or better is excellent.

- | | | | | |
|------|------|-------|-------|-------|
| 1. c | 5. b | 9. b | 13. a | 17. d |
| 2. c | 6. c | 10. a | 14. a | 18. c |
| 3. b | 7. d | 11. c | 15. b | 19. b |
| 4. b | 8. c | 12. d | 16. c | 20. d |

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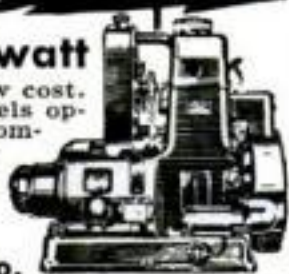
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Plastic Airplanes

(Continued from page 69)

As one engineer said: "It's like trying to mend a hole in a glass bottle."

Engineers are now working on this problem. In any case, this objection is not so serious as far as military airplanes go, for warplanes are usually either only slightly damaged, or are a total loss.

Another problem of plywood-plastic construction of military planes is that it requires rigid standardization. The designs of planes must be completely standardized before molds can be constructed. On the other hand, molds must be constructed in large numbers long before production of a particular model can begin. However, as the present European war proves, standardization of military aircraft is a distinct advantage.

There is one other test the plywood-plastic plane must pass—that of actual experience. This type of construction has passed every laboratory test that engineers could devise. Now it must pass the final acid test of thousands of hours of flight, flight in storm and calm, under every conceivable condition.

If it passed that test, America may have airplane production potentialities which will make the present-day skies, plane-filled though they are, seem empty.

Cartridges of Aluminum Now Thought Practical

RIFLE and machine-gun cartridges made of aluminum are a possibility suggested by a new German invention. Because of the great wartime demand for brass and copper, the substitution of aluminum for these relatively scarce metals in the manufacture of ammunition is considered highly desirable. It would also reduce the weight of ammunition, enabling soldiers to carry more.

In the past, the making of cartridges of aluminum has been considered impossible because of the low melting point of the metal, since the heat of firing would fuse the cartridge and weld it to the wall of the firing chamber, jamming the gun. In the new invention, this is said to be overcome by coating the outer surface of the aluminum cartridge with a very thin layer of aluminum oxide by means of electrolysis.

Because aluminum is more plentiful than brass or copper, its use is expected to reduce the cost of ammunition, in addition to conserving precious wartime metal supplies.

5 11 4

0 5

This One



EQXE-TK1-AY9L

Knots for a Hobby

(Continued from page 105)

of fancy knotting done on a miniature scale.

Of the more than 3,000 knots unearthed by Graumont and Hensel, perhaps 1,000 are almost invaluable in specialized trades. The remainder are variations or purely decorative knots. Surprising as it may seem, the average man or woman probably knows how to tie only three or four of these knots. Most people waste time and energy in making poor knots, when good knots could be made more easily. In the accompanying photographs, Hensel shows how to make a few good knots which every one should know.

One of the most ancient and useful of all these is the square or reef knot—an excellent knot for joining two lengths of rope or cord together. This knot is tied just as easily as the granny knot, which is often tied by mistake for the square knot, but which generally slips or jams so tight that it cannot be untied. The difference between them is merely in the way the ends are led out, and is clearly shown in the photograph.

A trick knot, which is really a square knot with the short ends coming out on opposite sides, is known as a thief knot. The story goes that it was invented by an old Cape Cod sea captain who suspected a member of his crew of stealing bread from the captain's bread bag. To trap the thief he tied up his bag one night with this variation, instead of with the usual square knot, which it resembles closely. In the morning the bag had been tied up again with the conventional knot, proving his suspicion correct.

A second knot which every one should know is a simple and secure package tie, which can be tied without fumbling about, and constant slipping of the cord. The neat and effective knot for tying up the end of a clothesline, or any other hanging rope, comes from sailing-ship practice, where it is used for tying up gaskets, lines used for lashing furled sails to the yards. By simply removing the final loop, the bundle of rope may be instantly shaken apart.

If your new shoe laces keep coming untied, Hensel suggests a knot guaranteed not to open. It is made, as shown in the illustrations, by passing one of the loops of the bow through the open knot before pulling it tight.

In their long pursuit of their joint hobby, Graumont and Hensel have uncovered the romance and fascination of knots. With the publication of their book, they will help to introduce others to an interesting and useful spare-time pursuit.

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27 mm.	1.98	95c B	37 mm.	2.49	95c C
28.5 mm.	1.98	95c B	39 mm.	2.49	95c C
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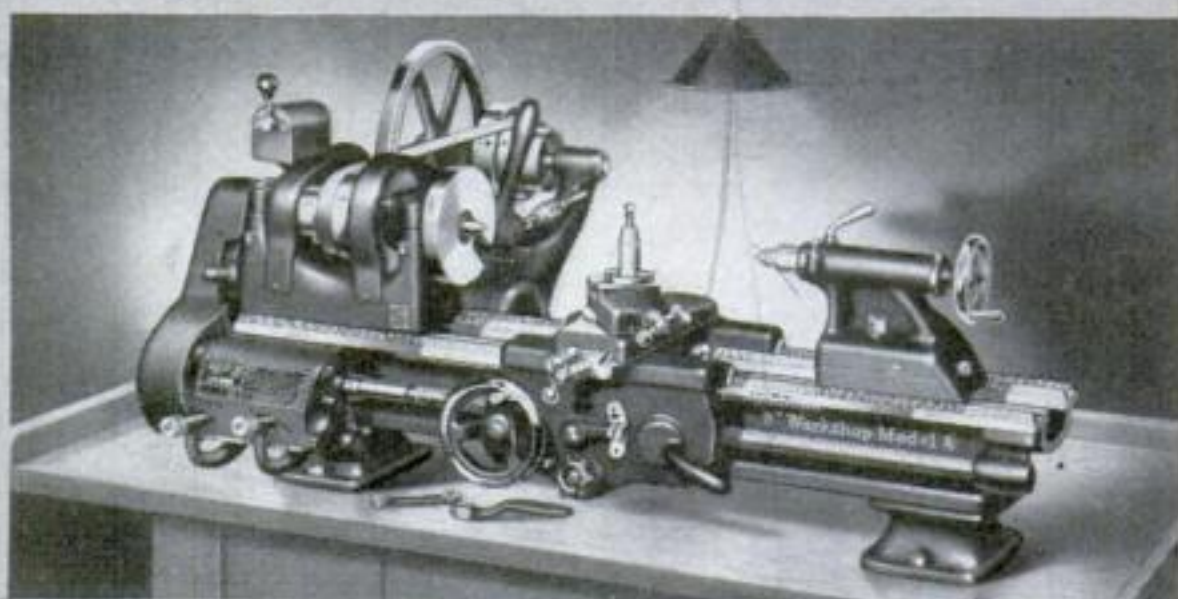
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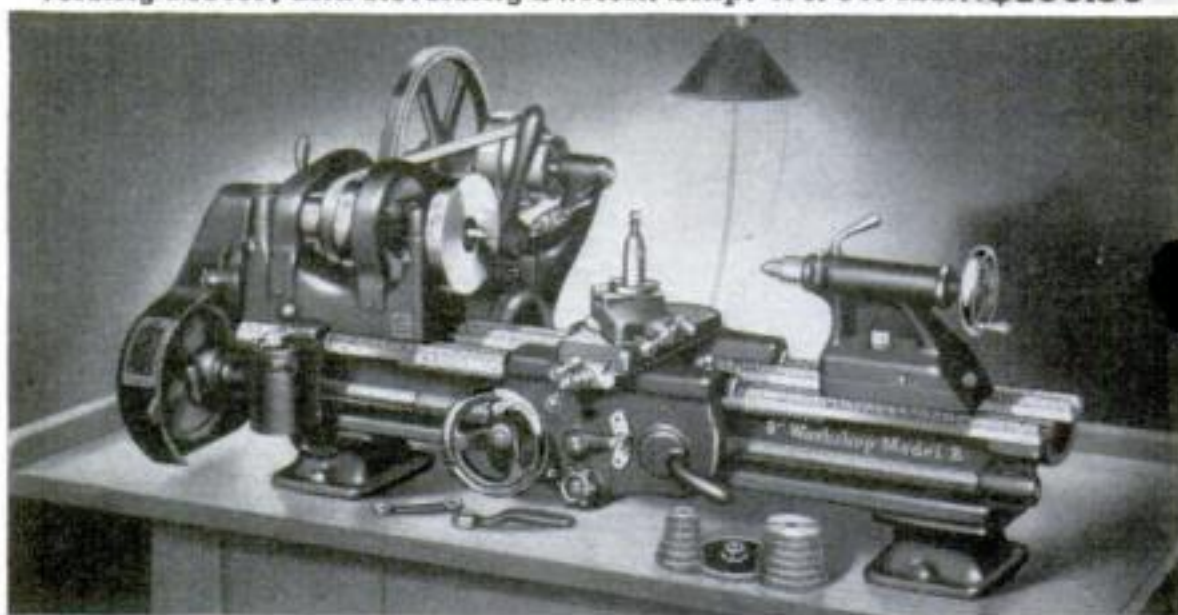
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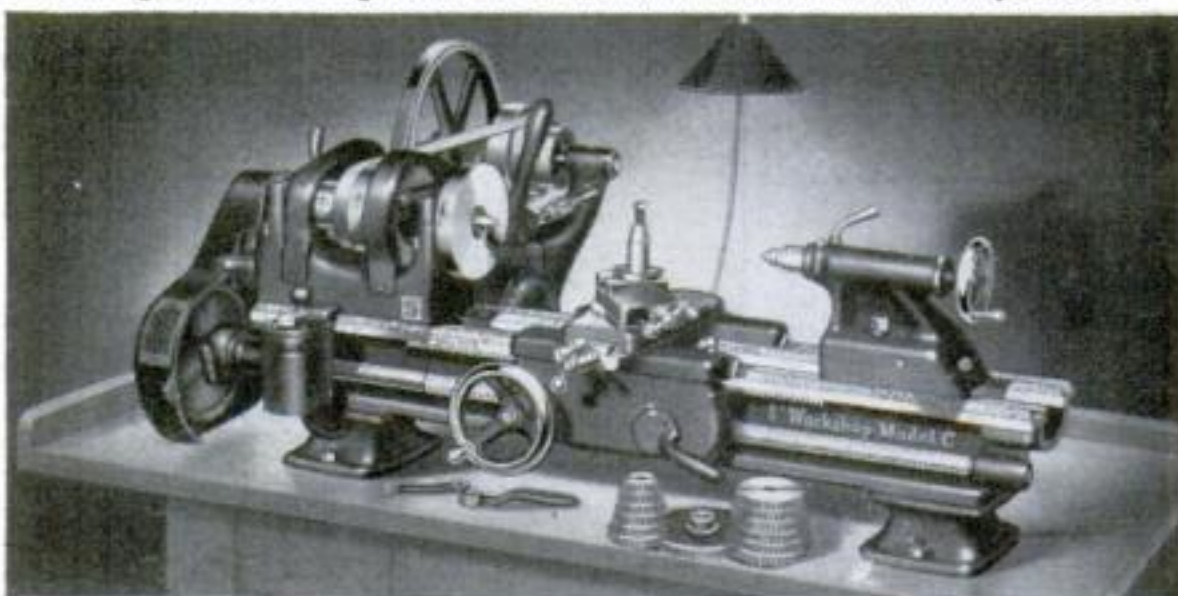
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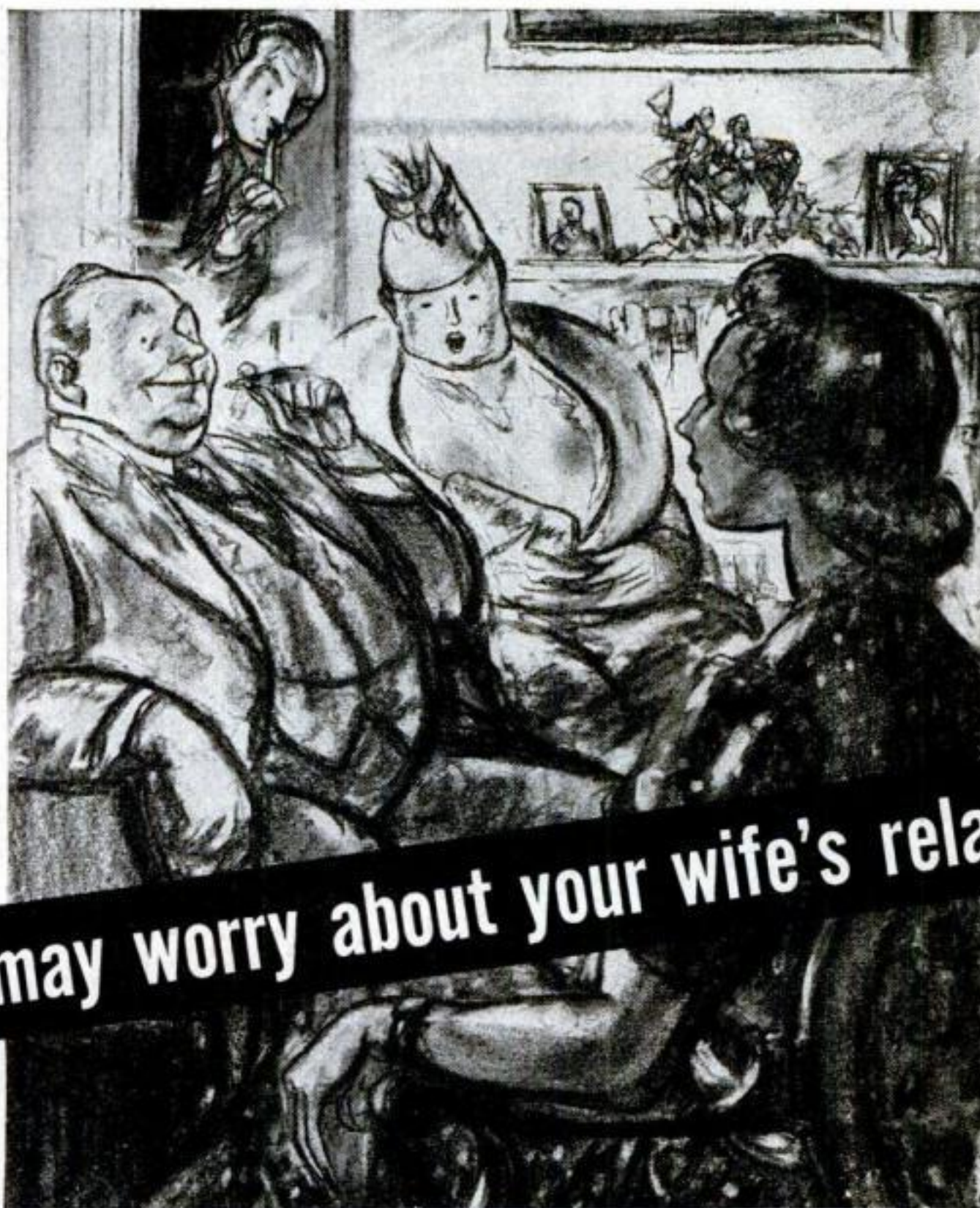


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